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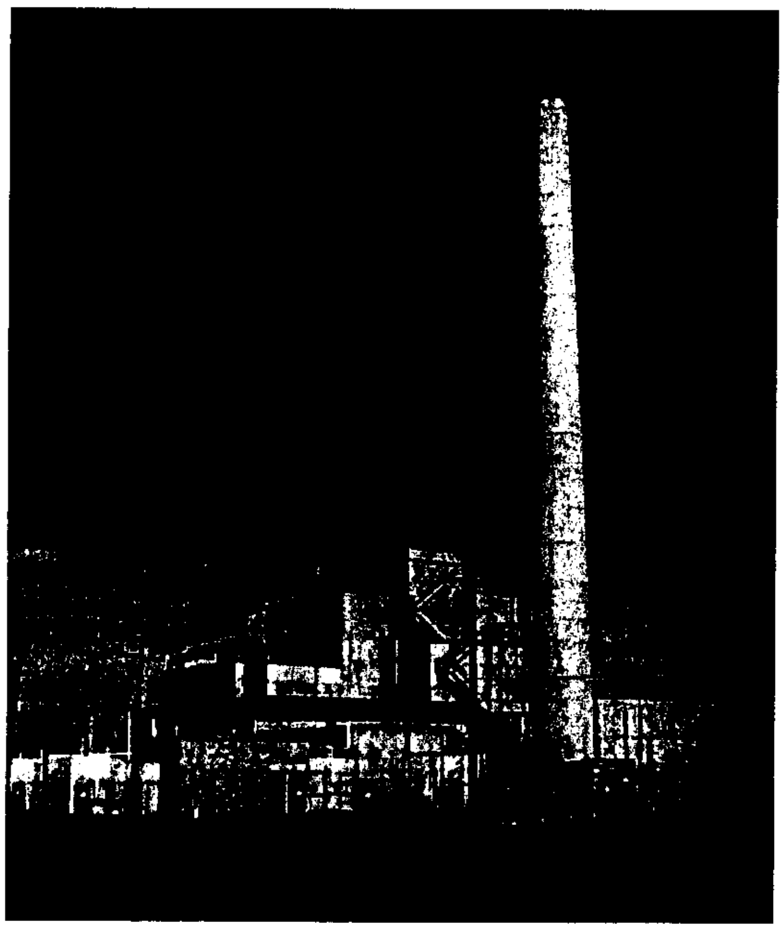
BHI-01384
Rev. 0

105-B Reactor Museum Feasibility Assessment (Phase II) Project



Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Environmental Restoration

Submitted by: Bechtel Hanford, Inc.

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105-B Reactor Museum Feasibility Assessment (Phase II) Project

Prepared for Bechtel Hanford, Inc., by MACTEC, Inc.

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EXECUTIVE SUMMARY

The B Reactor is located within the Hanford Site in the 100-B Area, on the south bank of the Columbia River. It is approximately 35 mi upstream and 32 road miles from the city of Richland, in the southeastern portion of Washington State, and is one of nine plutonium-production reactors constructed during the 1940s and the Cold War. Construction of the B Reactor began June 7, 1943, and operation began on September 26, 1944. The B Reactor was the world's first full-scale production reactor and produced plutonium for the first man-made nuclear explosion for the Trinity Test in New Mexico on July 16, 1945, and the bomb dropped on Nagasaki, Japan, on August 8, 1945. The reactor permanently ceased its plutonium-production operation in 1968. Because of its historical significance, the reactor was listed in the National Register of Historic Places on April 3, 1992. A portion of the B Reactor is currently functioning as a controlled-access tour area; however, minor hazards and deficiencies exist within the tour area that require corrective action before the public is allowed unescorted access.

This Phase II report is expected to meet the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-93-05 commitment for the third quarter of fiscal year 2000. The purpose of this report is to provide the basis and supporting documentation necessary to prepare the B Reactor as a facility open for partial, unescorted-access public tours.

To prepare the facility for unescorted access, potential hazards and deficiencies had to be identified by performing a walk-through with professionals representing the architectural, electrical, mechanical, and structural engineering disciplines; industrial and radiological health and safety; and fire and life safety. On the basis of a review of past evaluations and information gained from this walk-through, identification of the hazards and deficiencies in the B Reactor and proposed corrective actions are provided in this report.

The B Reactor Museum Association (BRMA), as the primary stakeholder, has been provided a review and comment period for the 60% and 90% reporting phases of this project. On the basis of the proposed corrective actions described in the 60% draft report, BRMA (in conjunction with the U.S. Department of Energy, Richland Operations Office) participated in selecting and generally reached consensus on the final mitigative measures necessary to ensure the health and safety of potential tour members visiting the B Reactor and to protect the environment. Engineering design drawings and associated costs to implement the measures were subsequently presented in the 90% draft report. Review comments received from BRMA on the 90% draft report have been incorporated into this final report. The selected measures reduce or eliminate risk to persons touring the facility, provide for appropriate accessibility under the *Americans with Disabilities Act*, and retain the character of the building to the maximum extent possible as a registered National Historic Place.

The major selected mitigative activities include providing ventilation to reduce the naturally occurring radon that accumulates in the tour area, providing new electrical service and de-energizing the existing service, removing sources of radiological contamination, providing necessary egress in the event of an emergency, and providing adequate barriers to prevent access by tour members to unauthorized areas of the facility that may have hazardous conditions.

To provide for accessibility requirements, a restroom facility with showers is recommended to be built in the vicinity of the reactor. In addition, exits and tour areas will be upgraded where needed to meet code requirements.

Because of the B Reactor's historic significance and to maintain its historical integrity, all mitigative measures have been designed to be as visually unobtrusive as possible while correcting deficiencies. An example of these measures is that the existing lighting will be refurbished and used in the primary tour route. In addition, custom-made replicas of existing doors are recommended for installation where appropriate to meet current building codes.

During the review/assessment of the primary tour route, it was determined that an additional egress route was required from the "work area." This egress route will be along the southern end of the valve pit and lunch room. In creating this egress, essentially an additional area of the B Reactor will be opened for touring.

A comprehensive fire hazard analysis was also performed to evaluate the entire B Reactor as it relates to the tour route. Recommendations resulting from this analysis are included in the selected mitigative measures.

Finally, detailed engineering drawings and associated costs are provided in this report for completing recommended hazardous mitigation activities.

After the recommended actions of this report are implemented, the tour route portions of the facility will meet the safety requirements necessary to allow unescorted access by the public. However, appropriate surveillance and maintenance activities must remain as a key requirement to maintain the structure for public access. A corrective action for the aging roof and exterior ventilation ducting was beyond the scope of this work but will be necessary in the near future.

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APPENDICES

FIGURES

TABLES

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ACRONYMS

ACM	asbestos-containing material
ADA	*Americans with Disabilities Act*
BHI	Bechtel Hanford, Inc.
BRMA	B Reactor Museum Association
CFR	*Code of Federal Regulations*
CMU	concrete masonry unit
DOE	U.S. Department of Energy
ECN	engineering change notice
ERC	Environmental Restoration Contractor
ERDF	Environmental Restoration Disposal Facility
HASP	health and safety plan
HFD	Hanford Fire Department
HID	high intensity discharge
IES	Illuminating Engineering Society of North America
NEPA	*National Environmental Policy Act of 1969*
NFPA	National Fire Protection Association
NHPA	*National Historic Preservation Act of 1966*
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
psf	pounds per square foot
RBA	radiological buffer area
RFAR	radio fire alarm reporting
RL	U.S. Department of Energy, Richland Operations Office
RWP	radiation work permit
S&M	surveillance and maintenance
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSCA	*Toxic Substances Control Act of 1976*
TSI	thermal system insulation
UBC	Uniform Building Code
WAC	*Washington Administrative Code*

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

1.0 INTRODUCTION

The B Reactor, located in the 100-B Area of the Hanford Site near Richland, Washington, is one of nine plutonium-production reactors constructed during the 1940s and the Cold War Era (Griffin and Sharpe 1999). Construction of the B Reactor began June 7, 1943, and operation began on September 26, 1944. The B Reactor was the world's first full-scale production reactor and produced plutonium for the first man-made nuclear explosion for the Trinity Test in New Mexico on July 16, 1945, and the plutonium used in the bomb dropped on Nagasaki, Japan, on August 8, 1945. The reactor permanently ceased its plutonium-production operation in 1968, and a limited portion of the facility is currently a controlled-access tour area.

Pursuant to Section 110 of the *National Historic Preservation Act of 1966* (NHPA), the U.S. Department of Energy (DOE), Richland Operations Office (RL) has the responsibility to preserve and protect historic buildings and structures located on the Hanford Site that are eligible for the National Register of Historic Places. The B Reactor was listed in the National Register on April 3, 1992. Protection of this historic property is provided through Stipulation V of the *Programmatic Agreement Among the U.S. Department of Energy, Richland Operations Office, the Advisory Council on Historic Preservation, the Washington State Historic Preservation Office for the Maintenance Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington* (DOE 1996).

This 105-B Reactor Museum feasibility assessment (Phase II) project report documents project activities that have been performed, including a review and assessment of previously existing information, a walk-through of the facility, an assessment of potential hazards, and selection of mitigative measures deemed to be appropriate to allow unescorted access by members of the public to a specified primary tour route. Detailed design drawings with associated cost schedules for the selected measures are also included in this report.

1.1 PURPOSE

Bechtel Hanford Inc. (BHI), the Environmental Restoration Contractor (ERC) at the Hanford Site, was requested by RL to provide a 105-B Reactor Museum feasiblity assessment (Phase II) project report. MACTEC, Inc. was selected as a subcontractor to provide this report under the review and oversight of BHI. Meier Enterprises, Inc., and Hughes Associates, Inc., provided the engineering design and fire hazard assessment, respectively, to MACTEC, Inc., for input into this report. This Phase II report is expected to satisfy the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) Milestone M-93-05 commitment for the third quarter of fiscal year 2000.

The purpose of this report is to provide the basis and supporting documentation necessary to reach a consensus on a cost-effective approach to prepare the B Reactor as a facility open for partial public tours with unescorted access. Final decisions on balancing among the mitigation of hazards, costs, and historical significance will be made by RL in cooperation with the B Reactor Museum Association (BRMA).

The objective of the 105-B Reactor Museum feasibility assessment (Phase II) project is to assess and document the activities needed to prepare designated areas of the B Reactor for use as a facility for public tours with unescorted access; it is not intended to address issues such as presentation of displays or the general ambiance necessary to create a museum. Therefore, this Phase II assessment evaluates hazards and provides designs and associated costs for the purpose of engineering safety improvements to mitigate potential hazards to the environment and those hazards that could pose a threat to persons touring the B Reactor.

1.2 SCOPE

The *Work Plan for the 105-B Reactor Museum Phase II Feasibility Assessment* (MACTEC 2000) described the approach for achieving the project objectives and outlined the scope and schedule for completing the 105-B Reactor Museum feasibility assessment (Phase II) project report and providing the necessary support during BRMA presentations. The scope of the Phase II report includes only the existing (primary) tour route. Other proposed tour areas discussed in prior documents were not included in this current assessment, except to the extent that hazards in other areas affected conditions in the primary tour route.

The essential elements of this report include a review of previously existing information of deficiencies identified during previous assessments, a description of results of the walk-through of the facility, and a detailed analysis and selection of mitigation options necessary to alleviate unsafe or deficient conditions in the primary tour area. Detailed engineering drawings and costs to implement the selected options are also provided. Appendix A provides a checklist and the criteria for the 105-B Reactor walk-through. As low as reasonably achievable documentation is provided in Appendix B. The fire hazard analysis is provided as Appendix C, and the engineering design package is provided as Appendix D.

2.0 DESCRIPTION

2.1 PHYSICAL DESCRIPTION

The B Reactor is located within the Hanford Site in the 100-B Area, on the south bank of the Columbia River. It is approximately 35 mi upstream and 32 road miles from the city of Richland, in the southeastern portion of Washington State (Figure 2-1). The B Reactor was permanently shut down in April 1969, and since that time the reactor has been in a condition of minimum surveillance and maintenance (S&M). A limited portion of B Reactor is currently functioning as a controlled-access tour area. Figure 2-2 provides a view of the B Reactor floor plan and the location of the primary tour route at the site. Figure 2-2 also includes the location of the proposed egress route from the work area. This egress route for future unescorted public access was determined to be necessary for emergency evacuation according to an assessment of the walk-through observations and an evaluation of applicable codes.

2.2 PREVIOUS WORK

Information regarding the status of the B Reactor is presented in *105-B Reactor Facility Museum Phase I Feasibility Study Report* (Griffin et al. 1995) and *Hanford B Reactor Building Hazard Assessment Report* (Griffin and Sharpe 1999). These reports identify hazards and recommended areas requiring additional evaluation during the Phase II assessment.

2.2.1 Summary of Phase I Feasibility Study

The purpose of the Phase I feasibility study report (Griffin et al. 1995) was to address the opportunities and viability of (1) maintaining the existing B Reactor with controlled access, (2) preserving and converting the B Reactor into a public access facility or visitor center, or (3) dismantling the reactor. A detailed analysis compared possible alternatives with two sets of criteria. The first set of criteria included compliance with state and Federal laws, safety issues, ability to implement, and political acceptability. The second set of criteria included a cost/benefit analysis. From this analysis, a conclusion was drawn that the use of the B Reactor as a tour facility is feasible and that there were several identifiable improvements needed to achieve this goal. Some of these improvements were aesthetic in nature, but the major emphasis of identified improvements related to a risk assessment (WHC 1993) of the existing physical conditions of the facility. In addition to this study, walk-throughs were performed for the Phase I feasibility study that provided further detailed information of physical conditions that required maintenance. Among the recommendations listed in this report was "engineering designs for upgrades required for selected alternatives shall be prepared at a level of detail sufficient for cost estimating and preparation of procurement packages" (Griffin et al. 1995).

Figure 2-1. Hanford Site Map.

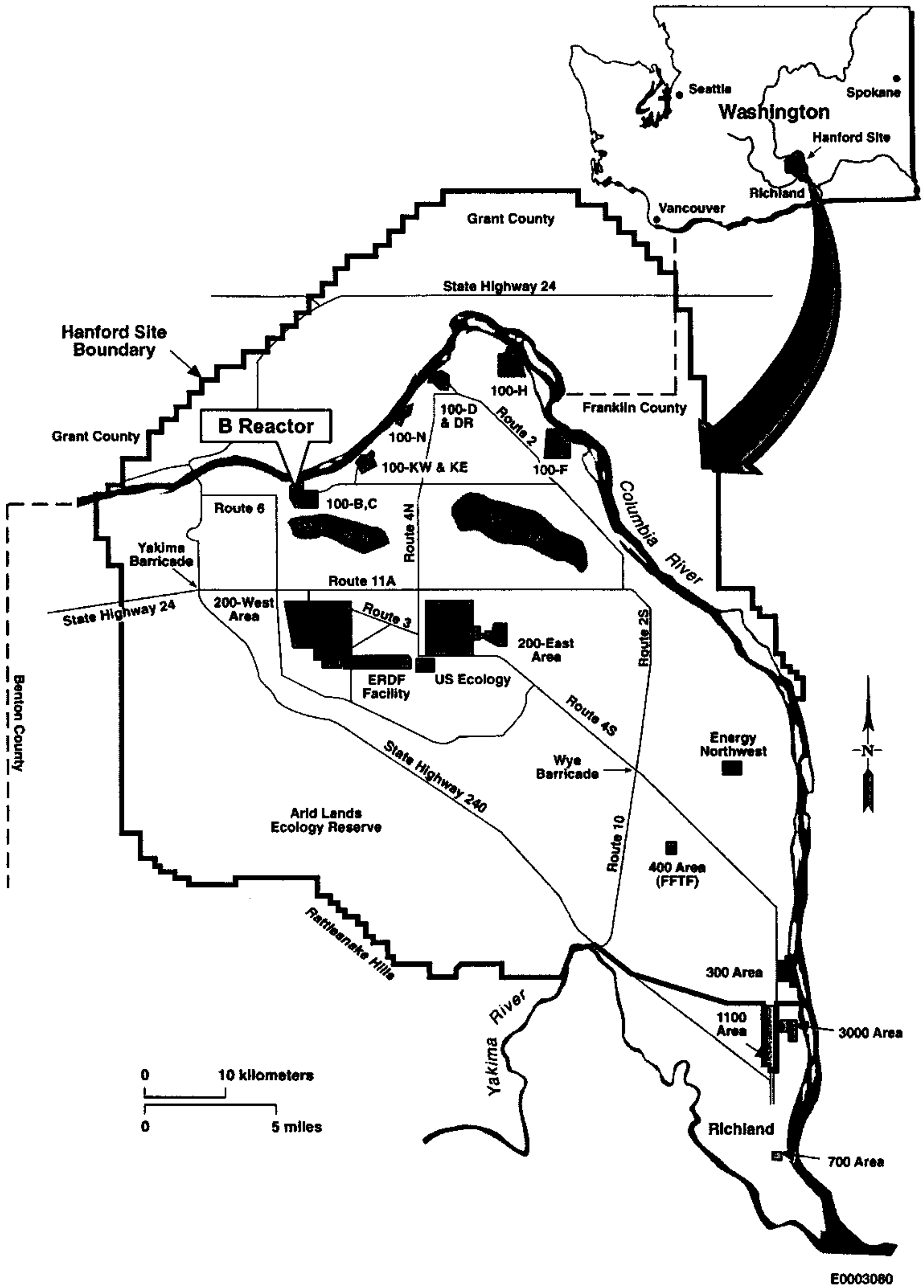
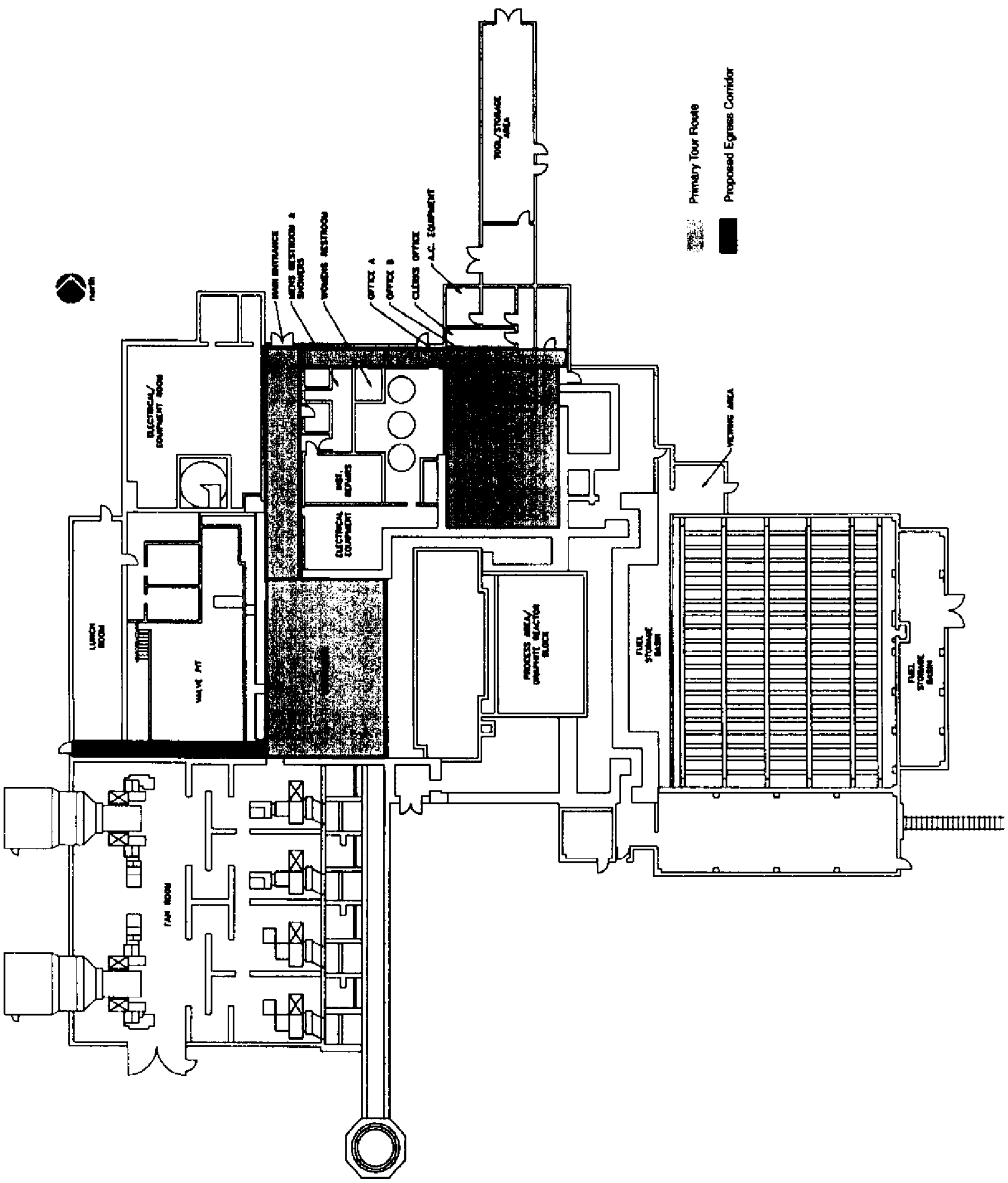


Figure 2-2. 105-B Reactor Building Floor Plan.



2.2.2 Summary of Hazard Assessment

The purpose of the hazard assessment (Griffin and Sharpe 1999) was to provide an assessment/characterization of the B Reactor building to determine and document the hazards that were present and that could pose a threat to the environment and/or to individuals touring the building. The report documents the potential hazards, determines the feasibility of mitigating the hazards, and makes recommendations regarding areas where public tour access should not be permitted. This assessment concluded that although some potential hazards were noted in the existing tour route, none of the hazards were of a nature to cause harm to anyone touring the facility.

Assessment activities included reviewing previously published documents describing past hazard/risk identification efforts at the B Reactor. The second major activity involved walk-throughs of most of the B Reactor to confirm the current status of hazards. The final activity was to determine if additional information was required to complete the assessment. It was concluded that numerous safety measures were needed prior to allowing public access to additional areas of the building for tour-related activities.

3.0 PROJECT APPROACH

The project approach for the Phase II feasibility project was to assemble professionals from a variety of disciplines necessary to complete a comprehensive risk assessment, to provide detailed designs for upgrades required for partial touring of the B Reactor building, and to provide information for BRMA presentations.

The professionals assembled for this project have expertise in the areas of architectural, electrical, mechanical, and structural engineering; radiation and industrial safety; fire protection; and risk assessment. These professionals approached the task by reviewing and evaluating past information and developing an understanding of deficiencies found by previous assessments. During this review, applicable codes and regulations related to the possible deficiencies were considered in the context of maintaining the historical integrity of the facility. Lists of areas of concern or regulatory compliance issues were also developed for use during the walk-through. It was the intent of the walk-through that all information be updated, where appropriate, to reflect the current condition of the building. Areas where corrective actions had already occurred since the prior risk assessment were noted, and any newly discovered deficiencies were documented. Photographs of many of the identified hazards and other locations were taken as appropriate.

The walk-through was conducted between March 6 and 8, 2000. After each day's activities, the professional team assembled to discuss findings and determine data collection needs for the next day. These assessment team's meetings were designed to ensure that all information and data necessary to complete the Phase II assessment were gathered efficiently and to reduce the possibility of revisits to the site. One revisit was conducted March 30 for the purpose of videotaping the tour route in its present condition, calculating an asbestos inventory, and placing detectors to measure the radon levels in the facility (see Appendix B).

Activities onsite during the walk-through were governed by a health and safety plan (HASP) and a radiation work permit (RWP). Training regarding the elements of the HASP and RWP was provided by BHI (prior to the walk-through) to protect personnel. These documents address the safety and health hazards at the site and specify the requirements and procedures for employee protection. Trained radiological control technicians were available to monitor activities and provide escorts where required.

Appendix A contains checklists used by the assessment professionals representing the architectural, electrical, mechanical, and structural disciplines; radiation and industrial safety; and fire protection. It should be noted that these checklists were intended to describe the general approach to achieving the project goals but were flexible in nature. After each day's walk-through, the focus of information gathering for the assessment was narrowed and revised according to observations during the walk-through and discussions in the assessment team's meetings. The checklists were completed after the walk-through to include the general findings.

After the walk-through, an analysis of all information was conducted and preliminary mitigative actions were selected and included in the 60% draft report, which was issued April 7, 2000. A meeting with RL and BRMA was conducted April 21, 2000, to discuss the content of the 60%

draft report and to reach a consensus on the final mitigative actions that would be necessary. As a result of these discussions, consensus was generally reached, detailed engineering designs with costs were prepared for the selected actions, and this information was presented in a 90% draft report. An additional meeting with RL and BRMA was held June 5, 2000, to determine the final disposition of review comments that resulted from the 90% draft report and the final content of the report.

4.0 MITIGATIVE ANALYSIS AND SELECTION

Site visits were conducted to observe the existing conditions along the primary tour route. Attention was given to reviewing the hazards identified by previous assessments, noting any mitigating or corrective measures taken to date and identifying other hazards or other deficiencies not previously noted. Hazards and other deficiencies have been identified on the basis of current codes and standards applicable to the building as a tour facility. It is understood that the building, due to its age, could neither be expected nor required to meet all current codes and standards. Recommendations for mitigating or corrective measures are based on reasonable and prudent application of these standards and are applied to conditions where such measures are essential or provide a substantive improvement to the safety of the building. The provisions of the "Washington State Historic Building Code" (*Washington Administrative Code* [WAC] 51-9) were considered to the fullest extent possible when considering corrective actions.

4.1 ARCHITECTURAL

4.1.1 Accessibility for Disabled Persons

The building was constructed and maintained with no provisions for access by the disabled. The *Americans with Disabilities Act* (ADA) requires all public facilities to be accessible to all persons, with special provisions for the blind, the deaf, and those who use walkers, wheelchairs, and canes.

The interior of the building is primarily constructed with concrete floors, the majority of which are constructed over the dirt grade, while other floor areas are over service tunnels, trenches, or utility corridors. The concrete floors are in good shape and are constructed in a level configuration. For the most part, the floors are exposed concrete with no covering or other finished surfacing; some areas have an epoxy-painted finish. The control room and adjoining office floors are finished with vinyl asbestos tile. All of these floor types are suitable to meet accessibility requirements.

The exterior areas around the building have undergone a considerable number of decommissioning activities over the past several years. As surrounding structures have been removed, the perimeter landscape has been replaced with river rock and crushed-rock material. The primary purpose of these materials is to provide dust control. A small area of asphalt material near the tool/storage area (at the northern entrance) serves as a loading area. The asphalt is very old and has broken apart in many locations. Currently this is the only paved parking area for the building. The parking capacity of the paved area is estimated at about 20 standard-sized automobiles, configured in a conventional parking arrangement. Figure 4-1 shows the front entrance to the B Reactor and the parking area located on the north side of the B Reactor. Two entry doors that provide access to the tour route in B Reactor are depicted in Figure 4-1. The double-door entry on the right side is considered to be the main entrance to be used by tour groups. A second entry door (open door in Figure 4-1) is shown in Figure 4-2. The door steps down to a small concrete walkway, which extends out to the north a short distance.

Figure 4-1. B Reactor Entrance and Current Parking Area.

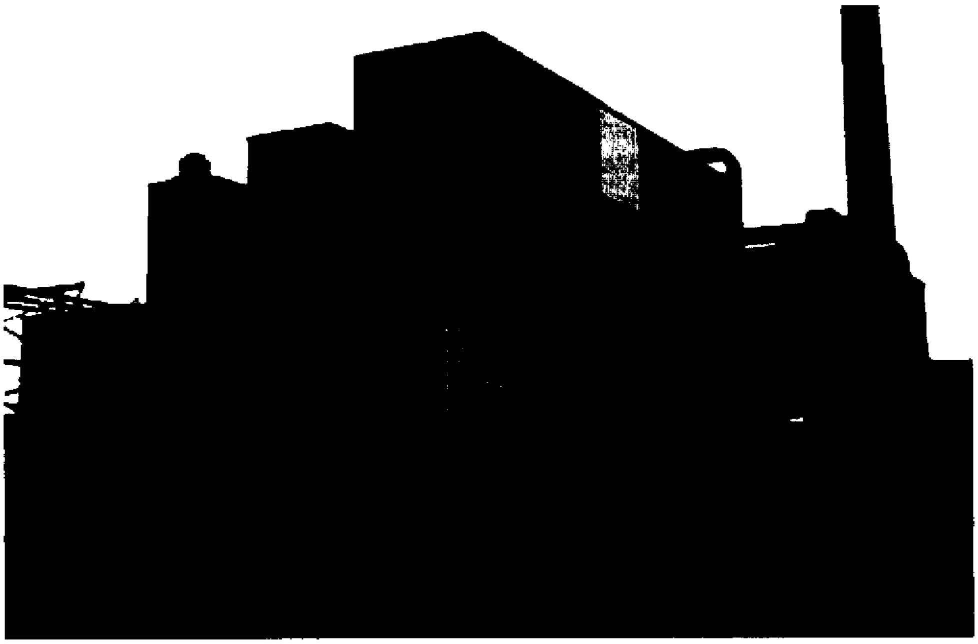
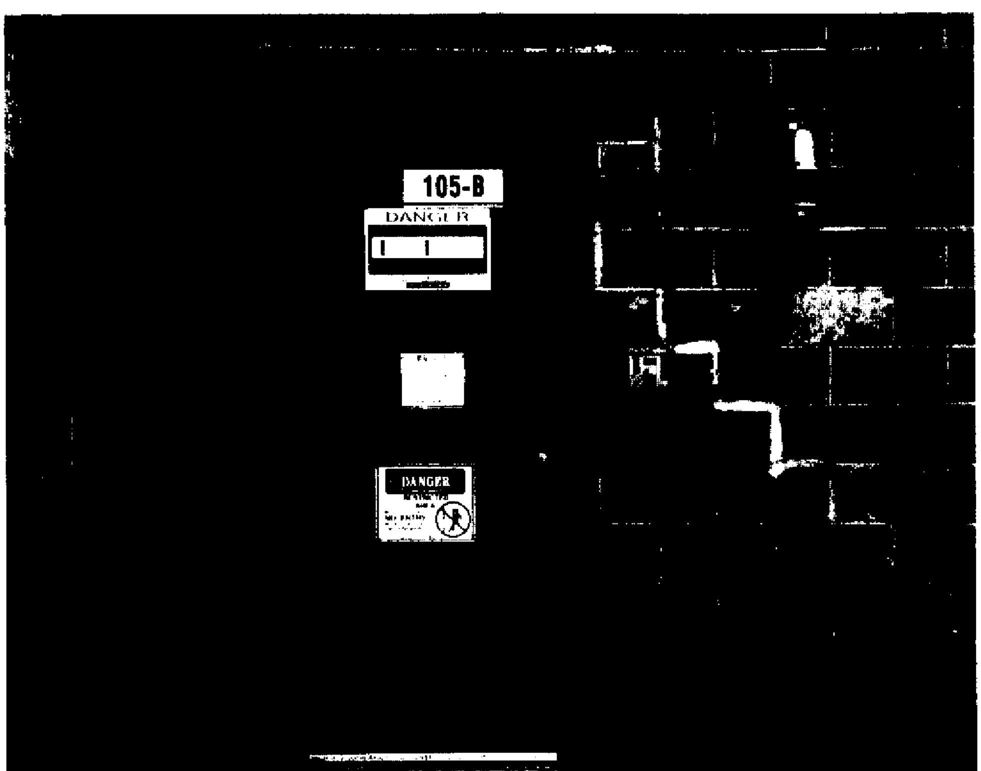


Figure 4-2. B Reactor Entry Door and CMU Deterioration.



The existing finished grade immediately surrounding the building is generally level with no significant elevation changes or steep slopes. The building perimeter is fenced with combinations of permanent and temporary 6-foot high, galvanized metal, chain-link fencing; several locking gates are installed.

The existing restroom facilities consist of separate men's and women's restrooms. The women's restroom is a small room with one lavatory, one water closet, and one shower stall; the men's restroom has three lavatories, three urinals, three water closets, and two shower stalls. These restroom facilities do not comply with the ADA codes. The doors to each of the restrooms have non-compliant hardware consisting of the round-knob type. There is not enough maneuvering space directly adjacent to the doors at either (corridor or restroom) side of the door. Neither restroom includes a compliant lavatory with compliant control fixtures, mirrors and dispensers, clear maneuvering clearances at the lavatory, a compliant handicapped water closet stall (minimum clearance width of 60 in. and toilet height of 17 to 19 in.), or a compliant shower stall.

To mitigate hazards and correct deficiencies associated with disabled person accessibility, the small steps at the entry doors on the north side of the B Reactor shall be removed and the transitions at the door thresholds shall be modified to meet ADA accessibility requirements (not to exceed the 0.5-in. maximum transition height). The existing door hardware shall be augmented with panic-exit hardware for ability of egress in case of emergency. An ADA-accessible route is required through these main entry doors. Another exit on the west side of the building (exit is proposed as part of providing emergency egress) also requires similar modifications for compliance with exiting requirements. However, this exit is not required to meet ADA accessibility requirements.

In addition, an accessible route must be provided from the parking area to the main entry door. There is sufficient space in the vicinity of the B Reactor to develop additional parking areas and a foot path leading from the building. Development of a parking area is outside the scope of this assessment, and design documentation and estimates of construction costs are not included.

The existing restrooms cannot be brought into compliance with current code without extensive building remodeling, including enlarging the footprint of the restroom area, and the restrooms should be secured from the public. A new restroom building is proposed to be built in the vicinity to serve the building. The restroom shall be ADA-compliant and have an adequate number of fixtures, as required by the Uniform Plumbing Code. Further details regarding this proposed restroom facility are provided in Section 4.3.1, "Sanitation." Shower facilities are proposed for staff and other authorized personnel in the new restroom building.

4.1.2 Occupancy

The occupancy type for a museum, as defined by the 1997 Uniform Building Code (UBC), is an assembly space. The classification of this space is also classified as an assembly space by the 1997 National Fire Protection Association (NFPA) *Life Safety Code* (NFPA 101). Each of these codes has specific construction requirements based on these occupancies.

The occupant load for the building is calculated using parameters stated in the UBC or NFPA, using standard square footage allowances. Table 4-1 lists spaces and associated occupant-load factors. It should be noted that the square footages listed are values for clear net-floor space only. The actual room sizes may be greater than the figures listed for each room.

Table 4-1. B Reactor Tour Area Occupant Load.

Area	Size (square feet)	Occupant Load Factor (square feet/person)	Occupant Load (No. of Persons)
Work area	2,200	15	147
Control room	650	15	44
Offices	250	15	17
Circulation/other	2,000	15	134
Total	**5,100**	**15**	**342**

The building was not designed with rated fire corridors and associated fire-rated doors/openings to properly separate these spaces. Therefore, the entire primary tour route must be analyzed as a single entity.

To mitigate the hazards and to correct the deficiencies associated with occupant load, the occupant load shall be administratively controlled rather than using the square-footage basis calculation. Because of the size, configuration, and manageability of the primary tour route, it is unlikely that the number of tourists present in the building at one time would approach the calculated occupant load. In addition, buildings that have an occupant load of more than 300 people are required to have a sprinkler system. However, installation of a fire sprinkler system in this building for reasons of occupancy is not warranted. The admission of visitors shall be administratively controlled by the tour staff to not exceed a posted maximum occupancy limit of 200. This limit is more realistic as to the likely number of tour members that would visit the facility at any one time and avoids over-design for items such as parking space, bathroom facilities, and door widths, as well as not invoking requirements for installing a fire sprinkler system.

4.1.3 Egress

On the basis of the anticipated occupant load for the building, each area on the primary tour route must be provided with two means of egress. The code requires that exits be separated by not less than one-half of the longest diagonal distance in any one space. In addition, no room, hall, or corridor can have a dead-end corridor or common path interval greater than 20 ft. The egress routes currently exit through the two doors on the north side of the building (see Figures 2-2 and 4-1). These routes provide adequate egress for the primary tour route areas, except from the front-face work area. The front-face work area becomes a dead-end corridor, unless an additional exit is provided out of this area. Egress signs are in place on several doors of the building; however, the signs are not compliant with current codes.

To mitigate hazards and correct deficiencies associated with building egress, an additional exit path is proposed out of the front-face work area through the south end of the valve pit room (Figures 2-2 and 4-3). This exit path is routed through areas located outside the primary tour route. The existing steel sliding door at the southwest corner of the work area or southeast corner of the valve pit room (in the center of Figure 4-3) shall be permanently fixed in the open position. Access will, therefore, be allowed into an egress corridor that exits through the south end of the valve pit area. This egress corridor shall extend from the opening where the sliding door now exists, through the valve pit area, along a grated walkway at the south end of the room, through the door at the southwest corner of the valve pit area (Figure 4-4) into the lunch room, and finally through the exterior door (Figure 4-5) at the southwest corner of the lunch room. The lunch room door leading from the valve pit, in addition to the steel sliding door, will be permanently fixed open to provide for the egress corridor. Providing for this egress corridor will require modifications to the grating on the walkway in the valve pit area. Steel-plate material will be installed over the existing grating to provide a solid surface. Ramps or other suitable transitions will be installed to accommodate differences in elevation between the concrete floors and the walkway grating. The existing handrails will be modified to prevent falling between railings. Barriers shall be provided to restrict access to other portions of the valve pit area and lunch room. Modifications to handrails and new barriers will be separate or otherwise clearly distinguishable from existing components and will not detract from the appearance of those components.

Figure 4-3. Valve Pit Egress Corridor.

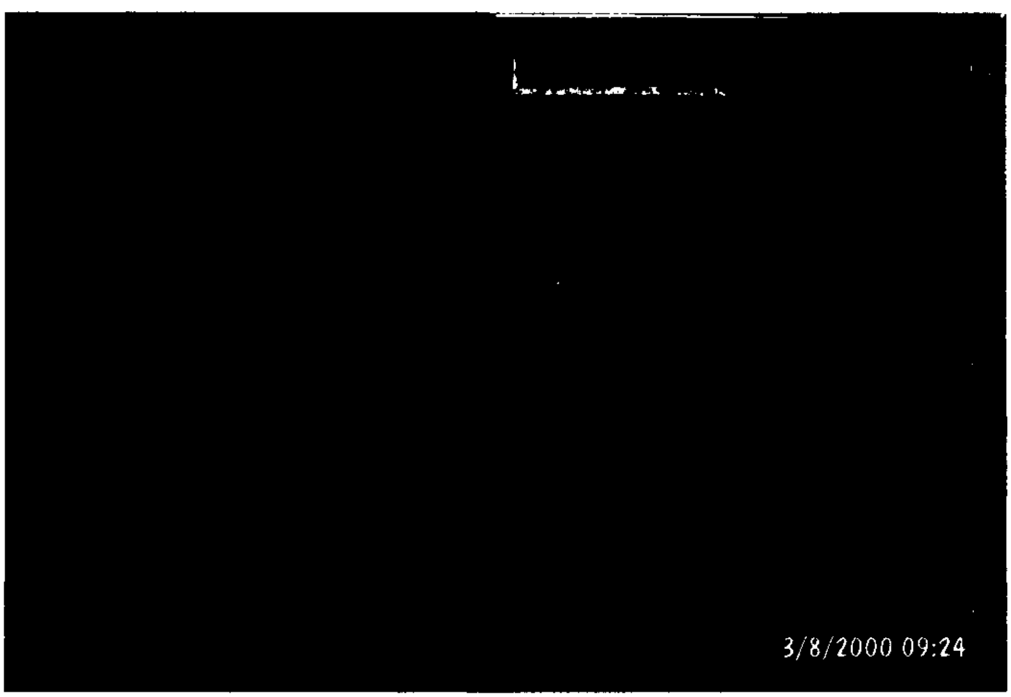
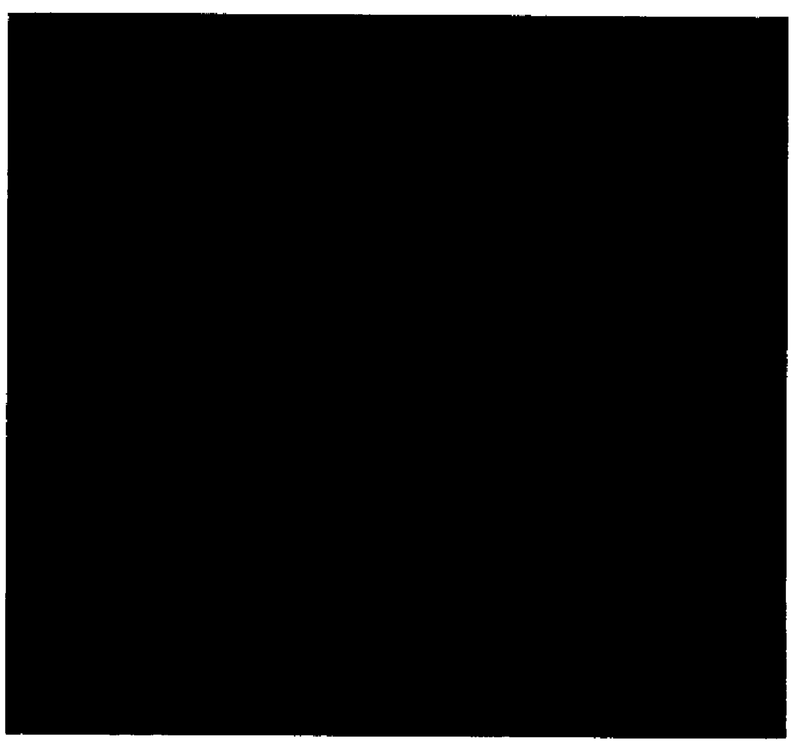


Figure 4-4. Lunch Room Entrance from Valve Pit.

Figure 4-5. Egress Exit Door from Lunch Room.



Finally, a properly sized concrete pad shall be installed outside the exterior door exiting from the lunch room. Exit signs along the primary tour route and the new egress route shall be replaced with exit-compliant signs, which includes labeling doors that lead to areas not on the primary tour route and that are not a path to an exit as "NOT AN EXIT." New signs shall be clearly distinguishable from existing room or door labeling to avoid confusion in the event of emergency egress from the building. Old signs can remain in place if there is no confusion; otherwise, the old signs will be removed and used for displays in an appropriate location. New lighting shall be installed specifically along the new egress corridor.

4.1.4 Materials and Construction

Concrete masonry units (CMUs) were used as exterior walls. The steel superstructure is the load-bearing structural component. When originally constructed, the CMU walls did not receive expansion joints to alleviate stresses associated with thermal expansion and contraction. As the weak link in the system, the movement was concentrated on the mortar joints. As a result, numerous cracks have occurred. Many of these cracks were repaired using additional mortar or other rigid materials (Figures 4-2 and 4-5). Each year, new cracks continue to form.

The roof, while not observed from above, appears to have numerous failures by evidence of water infiltration into the building's interior. There are several areas where roofing tar has seeped through breached locations of the roof, creating drips of tar on the walls, doors, and piping.

The existing exterior doors of the building appear to be original and are constructed of wood. Some doors have glazing units. Generally, door hardware and other types of controls are not compliant with codes for the disabled. Most door latchsets/locksets are the round-knob type. Several doors do have panic hardware; however, these devices are very old.

To mitigate the hazards and correct deficiencies associated with materials and construction, non-compliant door hardware along the accessible route shall be replaced. Emergency panic hardware shall be installed at all exit doors. Other door hardware shall remain, if it does not impact providing an accessible route, to preserve the historic character of the building. At the exit doors, the existing wood doors shall be replaced with new hollow metal doors and frames. Custom doors that replicate the appearance of the original doors shall be installed. Mitigating and corrective measures recommended for the roof and walls are discussed in the structural assessment (Section 4.2).

4.1.5 Public Access Control

Many areas within the tour route are not presently controlled adequately to prevent the public that may be unescorted from entering a dangerous location or other areas not intended for tour guests. Public access to unauthorized areas must be prohibited without limiting the viewing of items relevant to the tour group. Areas behind the control panels in the control room are open or partially controlled to preclude access. However, the existing plexiglass walls are partial height and allow passage below (Figure 4-6). The display panel barriers in the front-face work area protecting the reactor face could easily be bypassed. For example, Figure 4-7 shows the area behind the display panel in the southwest portion of the work area. A caged ladder just visible in the upper left of the picture can be reached and climbed. In addition, there is easy access to a radiological buffer area (RBA) that is presently only roped off. Doors to rooms entered from the main corridor that are not part of the primary tour route are unlocked or left open.

Figure 4-6. Barrier in Control Room.

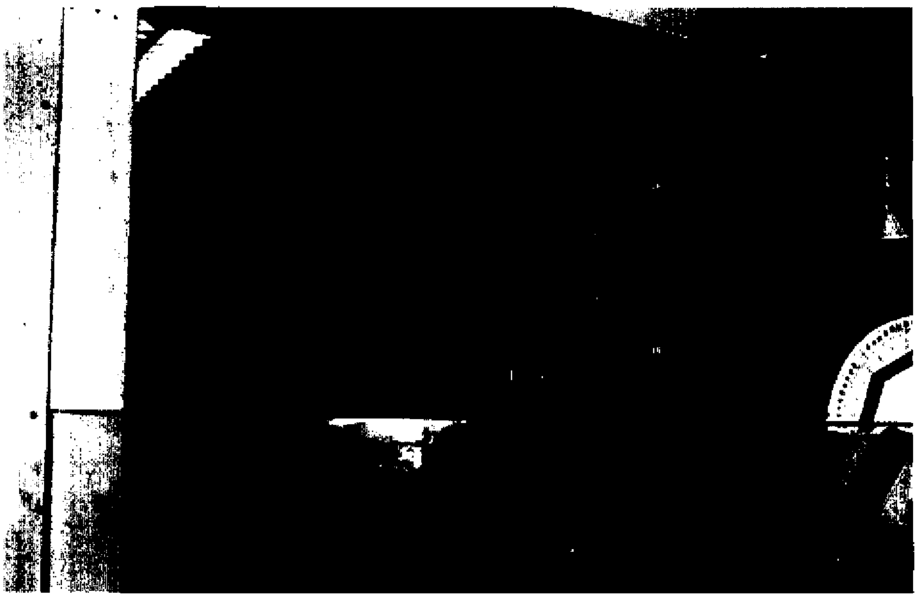
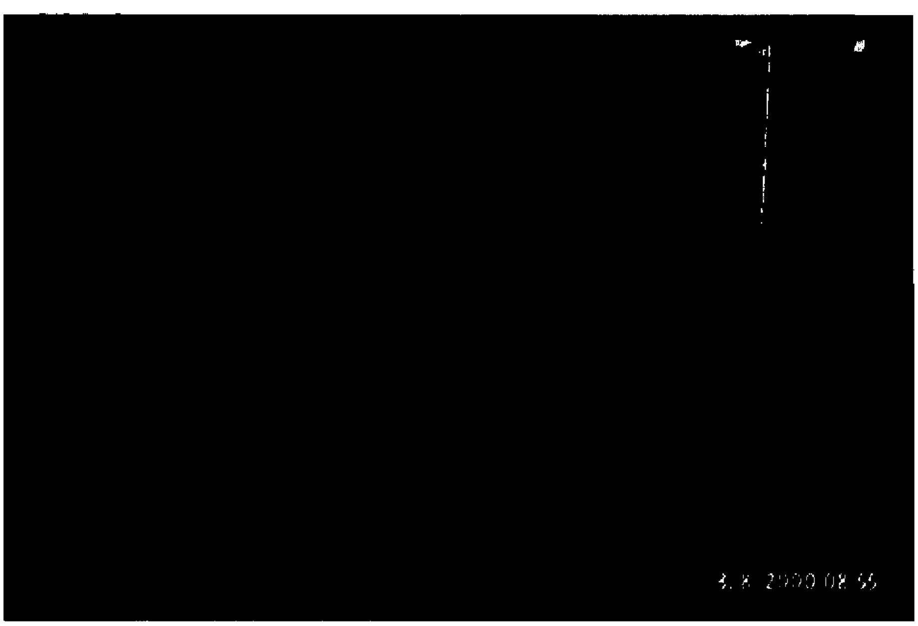


Figure 4-7. Public Access Control in Work Area.



To mitigate the hazards and correct deficiencies associated with public access control, areas behind the control panels in the control room and areas behind the display panels in the front-face work area shall be properly barricaded to prevent passage while maintaining visual access. The barricade to be erected in the area of the display panel in the southwest portion of the work area will also prevent access to the caged ladder. The barrier will allow access through the sliding steel door (visible on the right side of Figure 4-7), which will be permanently secured open for the new egress pathway. Barriers shall be arranged to completely block access to the restricted areas by the public but will allow access by S&M personnel. Each barrier will be securely attached to adjoining building structures. Plexiglass panels will be incorporated where viewing of components is desired. Doors to rooms entered from the main corridor shall be locked. New latchsets/locksets shall be installed where the existing door hardware is damaged or inadequate. Where viewing of a room is desired, plexiglass panels shall be installed in the doorways.

4.2 STRUCTURAL

4.2.1 General

The primary design criteria used to evaluate the adequacy of the building structure is the UBC. The fundamental purpose of the UBC is to protect building occupants from the most common hazards. Another purpose of the UBC is to protect the building from damage. Supplementing these documents are the requirements of the Occupational Safety and Health Administration (OSHA), the Washington State Industrial Safety and Health Administration, and the requirements of the building as a historic place. The codes require the structural elements to support a variety of forces. The design forces are as follows:

- Dead load – The vertical self-weight of the structure such as roofs, walls, and floors, as well as all permanent features such as fixed equipment.

- Roof live load – The load superimposed on the roof structure by the use of the roof such as rain, re-roofing or repair activities, and inspections. For this building, the basic roof live load is 20 pounds per square foot (psf), but the load can be reduced to 12 psf under certain conditions. However, the roof snow load will govern roof design because it will be the more restrictive criterion.

- Roof snow load – The load superimposed on the roof structure by snow, including snow drifts. For this building, the basic roof snow load is 20 psf, but the applied snow load is significantly higher in drift areas such as parapets and walls at higher and lower roof elevations.

- Floor load – The load superimposed on the floor structure is based on the use of the particular area. For this building, area types include assembly areas, storage areas, office spaces, and exit paths. The required floor load for assembly areas and exit paths is 100 psf.

- Wind load – The load superimposed on the roof and wall structures due to wind. The wind load for this building is based on a wind velocity of 70 miles per hour, with a wind exposure of "C" and a building importance factor of 1.0.

- Seismic (earthquake) load – The load superimposed on the structure due to seismic activity. The seismic load for this building is based on seismic zone 2B and a building importance factor of 1.0.

- Soil load – The load superimposed on the structure due to soil.

- Hydraulic (fluid) load – The load superimposed on the structure due to fluids such as water in the pool in the fuel storage basin; the pool is currently empty of water and will remain empty in the future.

Additional forces are sometimes considered but do not apply to this building due to its planned occupancy and use. These forces include hydraulic loads due to floods, ash loads due to volcanic activity, pressure forces due to piping, thermal forces beyond normal atmospheric conditions, and crane forces.

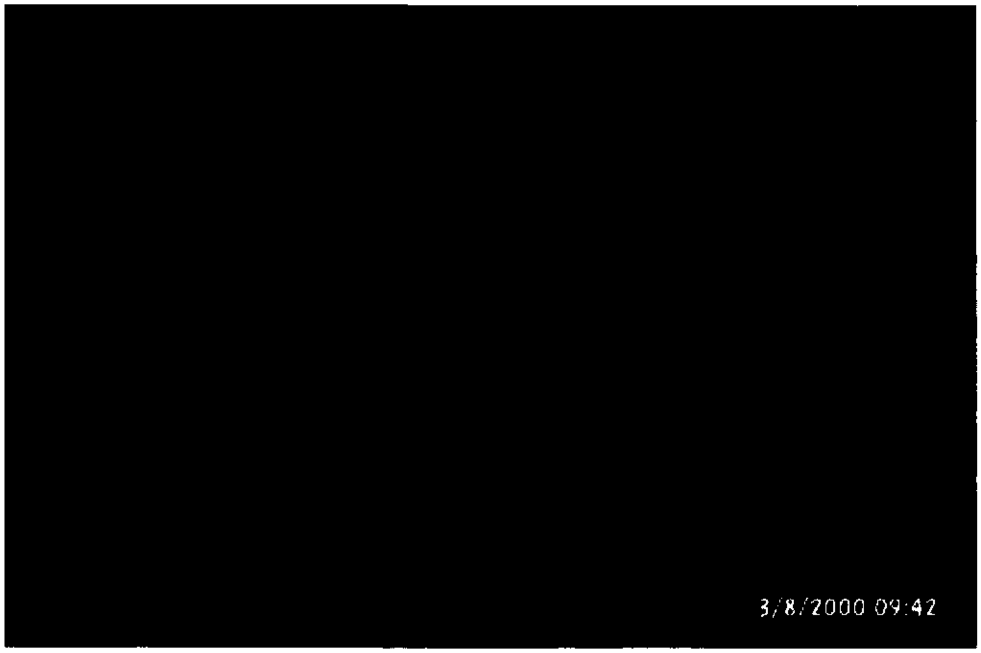
The most destructive force attacking the building structure is water. Heavy snowfall may have accumulated on the roof on occasion. More commonly, damage to the structure has occurred where water has penetrated through the protective roofs and walls and has caused corrosion or has damaged mortar or concrete. Freeze/thaw action has occurred to expand and open up otherwise small cracks and has resulted in additional damage. There are several roof leaks in the building and many walls are cracked. The following subsections provide additional background information for each structural component.

4.2.2 Roof

The roof structure above the primary tour route and proposed egress route in the valve pit room consists of concrete deck or pre-cast concrete roof panels (see Figure 4-8). The roofing consists of a built-up roofing covered with a slag or gravel-ballasted surface. The roof structure above the proposed egress route in the lunch room consists of 1x or 2x decking over wood joists. The lunch room has a gypsum board ceiling that did not allow observation of the decking and joists. Similar construction observable in other areas of the building appeared in good condition. Structure over the lunch room would be expected to be in similar condition unless there have been roof leaks in this area; however, no significant indications of leaking were observed.

On the basis of information reported in reference material item engineering change notice (ECN) 600276 (WHC 1994b), the total allowable roof loading is 50 psf. The total load is assumed to include both dead and snow loads. While this is probably adequate for most roof areas, there are several areas where snow drifts could occur. In these areas, the drift snow loads imposed by code requirements exceed 100 psf. Even in an undamaged condition in those areas where snow drifts can occur, the roof does not meet current code requirements. This also does not take into account any de-rating of the existing structure that may be applied in consideration of corrosion or aging of the structural steel.

Figure 4-8. Typical Roof Panels/Stains (Not in Primary Tour Route).



Repairs have been made to individual pre-cast roof panels that were showing signs of excessive deflection and corrosion. The repair included installing Unistrut members to support the damaged panel. The design for the repair is shown in reference material item ECN 600275 (WHC 1994a).

Total replacement of the pre-cast concrete roof panels is shown in reference material item ECN 600276 (WHC 1994b). The replacement has not been implemented. The design shows a light-gauge metal roof attached to the roof support beams. The new roof would prevent further roof leaks. Total replacement would be a complete fix rather than the isolated "Band-Aid" type roofing repairs that have been previously made. There would be no need for additional Unistrut members to support damaged panels. Removing the dead load of the heavier concrete panels increases the capacity of the roof system. The total structure weight of the roof would be decreased, so seismic roof forces also would be decreased.

There are disadvantages to the total replacement of the roof, as shown in reference material item ECN 600276 (WHC 1994b). From an aesthetic viewpoint, the new steel-panel system would look nothing like the original roof, altering the historic appearance of the building. It is not clear from the documentation whether diaphragm action to resist lateral forces was addressed by the design analysis. It is also not clear whether the existing roof beams were analyzed for the increased wind-uplift loads that will be present when the roof's dead load is substantially decreased due to the lighter components used for the roof replacement. In uplift conditions, the steel beam's bottom flange can buckle because it is not laterally braced.

To mitigate hazards and correct deficiencies associated with the roof, roofing should be repaired to prevent leaks that will cause further structural damage. Because the roof does not meet current code requirements for total-load capacity, the existing roofing materials must be removed prior to installing any new roofing materials. Roofing repair is being addressed by current S&M activities and planning. Therefore, design documents and estimates of construction costs are not included with this assessment.

Inspection of the pre-cast concrete roof panels should be performed on an annual basis, preferably after the winter snow season. Any damaged roof panels should be evaluated and repaired as necessary using an approved method such as the Unistrut fix outlined in reference material item ECN 600275 (WHC 1994a). Although this fix is visible from below, its appearance does not stand out from the otherwise industrial character of the building and is not distracting or obtrusive. An administrative S&M plan should be developed to remove snow or to inspect the building whenever the undisturbed snow depth on the ground exceeds 21 in., snow drifts in excess of 30 in. deep accumulate on the roof, new roof leaks are observed, or pre-cast concrete roof panels are observed deflecting.

Because the roof does not meet current code requirements for total-load capacity, addition of new loads to the roof structure should be restricted. Examples of new loads are fire sprinkler piping; heating ventilation, and air conditioning units; and electrical panels. The restriction should apply to items supported directly on top of the roof and items suspended from below the roof structure.

4.2.3 Walls

On the basis of visual inspection, the walls appear in good condition. However, there are numerous cracks in the CMU walls, as seen adjacent to the B Reactor entry door (see Figure 4-2). Available reference material suggests that some of the CMU walls are totally unreinforced. The cracks in the walls are likely the result of several factors. First, the walls do not have any expansion joints, resulting in thermal expansion and contraction. Second, the exterior face of the CMU walls appears to be unprotected. Water and sun have acted to diminish the strength of the mortar and the CMU itself. Last, the walls have been resisting vertical and lateral loads for more than 50 years.

To mitigate hazards and correct deficiencies associated with the walls, continued repair of mortar joints with an elastomeric sealant to prevent infiltration of water is recommended. Periodic observations should be made to identify areas requiring repair.

4.2.4 Floors

On the basis of visual inspection, the floors appear adequate for the required loads. The floors consist of concrete slabs along the primary tour route. Along the proposed egress route in the valve pit room, the floor consists of steel grating over structural steel beams. In the lunch room, it is believed that the floor consists of a wood sheathing over wood joists and beams. The floors felt stiff with no apparent deflection under light foot traffic. There are a few floor drains located along the primary tour route; the drains are currently inactive.

To mitigate hazards and correct deficiencies associated with the floors, openings to floor drains along the primary tour route shall be grouted, leveled to match the surrounding floor area, and painted to match the existing floor. In addition, metal-grate flooring in the proposed new egress corridor in the valve pit room requires modification, as described in Section 4.1.3.

4.2.5 Other Structures and Components

There is a bundle rack of process tubes (Figure 4-9) in the front-face work area suspended over areas where tour guests may walk. The strength of the supporting rack and crane cannot be verified and appears to be a potential falling hazard. The canvas drop shield in front of the reactor core (no picture available) is also suspended near areas where tour guests may walk. It is extremely heavy and is also a potential falling hazard. The support mechanism for the drop shield is as old as the building and is considered to be suspect. Roof leaks also were observed in the front-face work area.

Figure 4-9. Overhead Bundle Rack of Process Tubes.

The original ductwork on the exterior of the building appears to be rusted (see Figure 4-1 and front cover). Although not observed closely from the roof, the structural supports for the ductwork also appear to be rusted. The supports will eventually rust through and the ductwork would fall to the roof. Although the impact force is unlikely to cause any structural damage, falling ductwork would almost certainly damage the roofing and cause additional roof leaks. A more likely condition would be that a wind storm would cause the ductwork to fail, and pieces of the ductwork would become an airborne flying hazard. Although it would not travel far, the flying debris would be a hazard to someone on the ground in the vicinity of the building.

To mitigate hazards and correct deficiencies associated with miscellaneous structures and components, the suspended bundle rack and canvas drop shield shall be provided with a secondary supporting system (e.g., dead-man cable system) attached to the building structure to arrest the fall of these components in the event the original attachments fail. It is recommended that the exterior ductwork either be repaired or removed in the future. A replica of the ductwork could be added if desired. Design for this contingency is not in the current scope of work.

4.2.6 Seismic Forces

The ability of the building to resist current code-prescribed seismic (i.e., earthquake) forces is suspect. A detailed seismic analysis of the building is beyond the scope of this assessment; however, construction types observed or discovered are similar to methods known from experience not to be seismically resistant. For example, available reference information states that the precast concrete roof panels are not tied to the walls, the roof steel beams, or to each other. Without these ties, the roof "floats" on top of the walls and roof steel beams. In a seismic event, the mass of the structure is accelerated horizontally and, to a lesser extent, vertically, resulting in large horizontal forces that would result in this "floating" roof to move away from the walls. Another example is the construction of the walls. The CMU is already cracked, largely unreinforced, and almost certainly not built to current code standards. Unreinforced CMU typically performs very poorly in resisting seismic forces.

No mitigating or corrective measures are recommended to address application of seismic forces. Modifications to the building to resist current code-prescribed seismic forces would be extensive, costly, and not warranted based on the low probability of a significant seismic event.

4.3 MECHANICAL

4.3.1 Sanitation

Raw water is supplied to the building from the export water system from the 182-B reservoir. Bottled water dispensers are currently provided for drinking water. Sanitary sewage from the restroom facilities has been discharged to an onsite septic system. The plumbing systems in the building were shut off during the assessment walk-throughs but have since been turned back on. The lavatories in the restrooms are in good condition and have been cleaned. The toilets are in fair condition but have not been cleaned. There is a great deal of staining, particularly below the normal water line in the toilet bowls. The fixtures and trim do not meet current disabled persons accessibility standards.

The restrooms would need substantial remodeling to provide the required number of fixtures and the required disabled persons accessibility. Some of the toilets and all of the lavatory faucets would need to be replaced with fixtures and trim meeting disabled persons accessibility requirements. The internal condition of the piping is suspect. It is also likely that the onsite septic tank system would have to be replaced.

To mitigate the hazards and correct the deficiencies associated with sanitation, the water and sewer systems in the building shall be deactivated, and the restroom facilities in the building shall not be used. Waste piping shall be plugged at fixture outlets to prevent any remnant sewer gas from entering the building. Plexiglass barriers shall be installed in the doorways to allow viewing of the rooms from the primary tour route.

To provide required sanitary services, a new, stand-alone, self-contained unit with the proper number of fixtures for the new occupancy and properly configured for disabled persons accessibility shall be constructed in the vicinity of the B Reactor. Specific siting of the new structure is not within the current scope of work because there are many details (e.g., co-locating a guard shack/badge house and parking area with the restroom) that have not yet been determined. Water shall be supplied to the building from the 100-B Area export water utility. Postings shall be attached at restroom fixtures indicating, "NON-POTABLE WATER, DO NOT DRINK." Bottled water sources shall be provided for drinking.

4.3.2 Ventilation

The original building ventilating systems are currently inoperable. Ventilation for radon control is being affected by opening doors and drawing air through the building with portable box fans. The ventilation air is not heated and the building gets uncomfortably cold during the late fall, winter, and early spring. The cold temperatures also have adverse effects on interior finishes. The open doors also allow dirt and animal entry. The building is typically ventilated for about 2 hours prior to tour groups arriving at the building.

To mitigate the hazards and correct the deficiencies associated with ventilation, new ventilating fans shall be installed in the primary tour route areas, except for the control room. The fans shall discharge to the outdoors through the exterior walls. The fans shall be sized to provide ventilation for occupants and for radon mitigation in the areas served. Ventilation for the control room shall be integrated with the proposed heating and air conditioning system described in Section 4.3.3.

4.3.3 Environmental Control

The original building heating systems are currently inoperable. The original equipment, except for the fan unit that served the control room, and the original supply and exhaust ductwork are still in place. Ductwork on the exterior of the building appears to be rusted. Some of the exterior ductwork may have rusted through, creating holes through which rainwater can enter. Past occurrences of rainwater staining were observed on the ceiling of the front-face work area from the vicinity of the grilles and registers. Much of the steam and condensate piping for heating is also still in place. A small through-the-wall heating and air conditioning unit has been installed to serve the tool/storage area. This unit has been installed to provide a tempered environment for miscellaneous items stored in the building.

Another through-the-wall heating and air conditioning unit has been installed to serve the control room. Ductwork has been installed from the discharge louver of the heating and air conditioning unit and connected to existing supply ductwork serving the control room. Through-the-wall heating and air conditioning units are not intended to be ducted in this manner. Air return from the control room migrates out through doors and cracks into adjoining spaces. The heating and air conditioning unit draws intake air from the equipment room in which it is located. Air infiltrates from adjoining spaces and from leakage to the outdoors.

To mitigate the hazards and correct the deficiencies associated with environmental control, electric unit heaters shall be installed in the current tour route areas, except for the control room, to maintain temperature conditions for the comfort of tour guests and for protection of interior finishes. Refrigerated cooling systems are not warranted for the front-face work area and adjoining areas. Instead, the ventilating fans shall be operated to use cool night air to purge residual heat from these areas. The height and thermal mass of these areas will allow the indoor temperature to hold through most of the day until the night ventilation cycle can resume. Ductwork penetrations through the building roof and walls shall be blanked off and sealed.

The through-the-wall heating and air conditioning unit now serving the control room shall be replaced with a new electric split-system heat-pump system. The fan/coil unit shall be located in the existing equipment room. Ductwork shall be installed to connect the fan/coil unit to the existing supply and return ductwork serving the control room. A new intake louver shall be installed in the wall opening vacated by the through-the-wall unit. Ventilation air shall be introduced through the louver and connected to the return air ductwork near the fan/coil unit inlet. The heat pump unit shall be located outdoors in a visually unobtrusive location on the east side of the tool/storage area. Additional grilles shall be installed in the supply and return ductwork as it transits the entry corridor to also condition this area. The new system will maintain temperature conditions for the comfort of tour guests and for protection of interior finishes. The new system will also provide ventilation for occupants and for radon mitigation in the areas served.

4.3.4 Fire Suppression

The water supply for fire suppression is supplied to the hydrants from the export water system from the 182-B reservoir. Two fire hydrants are located in the vicinity of the building. No automatic sprinklers, interior standpipes, or other special hazard fire suppression systems are installed in the building. Portable fire extinguishers are provided sporadically along the current tour route. The number and location of fire extinguishers do not meet requirements of NFPA 10, *Standard for Portable Fire Extinguishers*.

To mitigate the hazards and correct deficiencies associated with the fire suppression systems, additional fire extinguishers shall be installed along the primary tour route. Installation of automatic sprinkler systems, interior standpipes, or other special hazard fire extinguishing systems is not warranted. Additional details regarding fire suppression are included in Appendix C, "Fire Hazard Analysis."

4.3.5 Miscellaneous Mechanical Components

Steam and other utility piping is routed through various portions of the tour route. Some of the piping is located low enough overhead to be reachable, although not without jumping up. Piping rises from the floor to the overhead space in several places along the tour route. Large valves with protruding valve stems are located in the risers; however, there is adequate clearance to avoid running into the piping and valves. In general, the piping is adequately supported but is not braced for seismic movement. Much of the piping is insulated with asbestos-containing materials (ACM); further discussion of ACM is included in Section 4.5.1.1.

No mitigating or corrective measures are recommended for the majority of miscellaneous mechanical components. Steam and other utility piping shall remain in place. The location of the piping does not pose a significant hazard to tour guests, except for vertical stands of piping where tour visitors could breach the ACM. About 30 linear feet of vertical piping will have protective jacketing placed. Because the building itself does not meet current seismic requirements, seismic bracing of the piping is not warranted.

4.4 ELECTRICAL

4.4.1 Power

Electrical power is supplied to the building from the 100-B Area overhead 13.8-kilovolt distribution lines. The overhead lines originally distributed power at 2.4 kilovolts during the operational era of the building. Projects completed in the late 1980s and early 1990s converted these overhead distribution lines from 2.4 to 13.8 kilovolts. The reactor operating systems in the building are currently shut off. Efforts have been made to de-energize reactor control cabinets, ventilation systems, cooling water pumping systems, and other electrically driven equipment. The energization status and the internal condition of the electrical systems are not known in detail.

The majority of the electrical distribution equipment is the original equipment installed in the early 1940s. Replacement parts are no longer available and the equipment has exceeded its intended life. At present, 120-volt single-phase and 480-volt three-phase electrical power are available throughout the building. Currently, there are no power requirements other than general lighting, display lighting, convenience or display receptacles, and power for the heat detectors and wall air conditioning units and unit heaters.

Conduit is routed through various portions of the primary tour route. Some of the conduit is located low enough overhead or is wall-mounted low enough to be reachable, however, there is adequate clearance to avoid the conduit and panels. In general, the conduit is adequately supported, but is not braced for seismic movement. The condition of the wiring and wiring insulation is suspect.

To mitigate the hazards and correct deficiencies associated with electrical power, the existing electrical systems in the building shall be deactivated and the distribution panelboards, lighting panelboards, and control panels in the building will not be used. Demolition of the existing fixtures or systems is not warranted due to the historical value of this equipment. Safety to personnel and visitors can be ensured by isolating the existing equipment from all energized electrical equipment. All concerns of touch and reach shock hazards are thereby eliminated.

A new 400-amp, 208/120-volt, three-phase, four-wire panelboard shall be installed to provide power for the general lighting, display lighting, general receptacles, display receptacles, and building heating, ventilating, and air conditioning equipment. The new service and distribution equipment shall be placed in rooms that will be locked or otherwise secured to prevent access by unauthorized personnel or the public. Providing 480-volt electrical power to the building is unnecessary and adds to the potential for severe and fatal injury. A supply voltage of 208/120 volts is adequate for the types of fixtures and electrically driven equipment that will be installed in the building. Multi-outlet strips shall be installed in all display areas; the strips shall be wall-mounted behind display locations up out of reach of small children. General building convenience receptacles shall be installed so any location of serviceable equipment is not more than 25 ft from the nearest receptacle. The receptacles are provided primarily for maintenance and housekeeping purposes.

Other hazardous conditions identified in previous assessments regarding the electrical systems have been or are in the process of being corrected. Hazards such as missing wireway covers in the front-face work area and wire ends hanging out of the wireway by the entry to this area are mitigated by de-energizing all existing electrical equipment and wireways. Other hazards (e.g., exposed wiring and accessible fuse panels) are also mitigated by this measure.

4.4.2 Lighting

Lighting fixtures on the primary tour route were being relamped during the site visits. The building does not maintain lighting outside of the primary tour route. Lighting levels in most areas on the primary tour route are adequate. The Illuminating Engineering Society of North America (IES) recommends illumination levels between 10 and 20 footcandles, with the median being 15 footcandles, for museum lobby areas, general gallery areas, and corridors. The recommended illumination levels for displays that are not subject to light damage range from 20 to 50 footcandles, with the median being 30 footcandles. Lighting-level measurements were taken in each of the primary tour route areas. The results for each area are as follows:

- <u>Entrance corridor from northwest entrance to work area</u> – Measurements ranged from 10 to 25 footcandles, with the majority of the readings being above the 10 footcandle minimum recommended by IES.

- <u>Work area</u> – Measurements ranged from 2 to 3 footcandles without the ceiling lights turned on. The only lighting that was turned on was the display lighting and a few flood lights aimed at the reactor front face. On a subsequent visit, the ceiling lights were turned on. Additional measurements were not taken; however, the ceiling lights seemed to supply adequate light levels. The lighting level in this area should be around 30 footcandles on average.

- <u>Corridor to control room from entrance corridor</u> – Measurements ranged from 4 to 20 footcandles, with the majority of the readings being below the 10 footcandle minimum recommended by IES.

- Control room – Measurements ranged from 7 to 136 footcandles, with the majority of the readings being about 100 footcandles, which is well above the maximum level recommended by IES, even for display areas (50 footcandles).

- Office A – Measurements ranged from 17 to 75 footcandles, with the majority of the readings being about 90 footcandles, which is well above the maximum level recommended by IES, even for display areas (50 footcandles).

- Office B – Measurements ranged from 50 to 95 footcandles, with the majority of the readings being about 90 footcandles, which is well above the maximum level recommended by IES, even for display areas (50 footcandles).

- Proposed additional egress path from the work area – Measurements ranged from 0.5 to 11 footcandles, with the majority of the readings being well below the 10 footcandle minimum recommended by IES.

To mitigate the hazards and correct the deficiencies associated with lighting, additional light fixtures shall be installed in areas that are currently below minimum illumination levels recommended by IES. To enhance authenticity of the lighting in the building, the lighting fixtures shall be restored similar to those originally provided. The original light fixtures, currently stored in the tool/storage area, shall be delivered to a lighting fixture manufacturer for rebuilding. Asbestos wiring and insulating materials shall be removed and the fixtures shall be reworked with modern fixture wire and sockets. Modern high intensity discharge (HID) lamps shall be used rather than incandescent lamps, which will result in efficient and easily serviceable fixtures with the basic appearance of the original installation. Additional accent lighting shall be added for displays and items of particular interest, such as the front face of the reactor.

The lighting in the primary tour areas shall be recircuited from the new power distribution panelboard. The entry corridor lighting fixtures shall otherwise remain as is. The front-face work area lighting shall be upgraded using the rebuilt old fixtures with new wiring and HID lamps. The lighting in the corridor to the control room from the entry corridor shall be supplemented by installing additional ceiling-mounted fluorescent fixtures. The existing control room light fixtures shall be relamped using lower wattage fluorescent lamps. Task lighting fixtures shall be installed to highlight particular work stations for desired effect. Fixtures in offices adjoining the control room shall be replaced with new fluorescent fixtures. Additional light fixtures shall be installed along the proposed new egress path from the front-face work area. Effort shall be made to preserve the appearance of the original fixtures when using modern Underwriter's Laboratory approved, energy-efficient ballasts, lamps, lamp holders, and insulation. Where light fixtures have reflectors or lenses, the existing reflectors and lenses shall be used on the modern replacement fixtures. Existing ballasts may contain polychlornated biphenyls (PCBs) and will require special disposal as they are replaced.

4.4.3 Emergency Lighting

Several emergency light fixtures are located along the primary tour route. Section C.8.7 of Appendix C describes the locations of lighting. The lights are installed sporadically at irregular intervals and locations. Many lights are mounted within easy reach of tour guests and are well below the required mounting height. In addition, the emergency lights are connected to general receptacle circuits rather than the normal lighting circuits of the area. This is a violation of National Electric Code Article 700-12(e) for unit equipment. The branch circuit feeding the unit equipment must be the same branch circuit as that serving the normal lighting in the area and must be connected ahead of any local switches.

To mitigate the hazards and correct the deficiencies associated with emergency lighting, emergency light fixtures shall be installed throughout the primary tour area and egress corridor. Locations shall be chosen to minimize the visual impact of new battery packaged units. All areas shall receive adequate emergency illumination to ensure safe egress on loss of power to the building. Where suitable to the type of light fixture installed, internal battery-pack ballast units or remote battery-pack ballast units shall be provided. This applies to fluorescent fixtures in the control room and adjoining offices. Recommendations for emergency lighting locations are included in Section C.19.3 of Appendix C.

4.4.4 Exit Marking

No exit signs are installed in the building. All egress paths must have adequate exit signs directing visitors to the nearest exit.

To mitigate the hazards and correct the deficiencies associated with exit marking, lighted exit signs shall be placed above all doors used for emergency egress. In addition, directional lighted exit signs shall be installed to guide visitors to the nearest exit. These directional signs shall be located throughout the primary tour area so no position in any area is out of view of a directional lighted exit sign.

4.4.5 Fire Alarm Systems

Four heat detectors and one fire alarm bell are currently in service and are located in the control room. The ability to report alarm activation to the Hanford Fire Department (HFD) was removed when the building was decommissioned. The previous location of the radio fire alarm reporting (RFAR) box is visible near the entry.

To mitigate the hazards and correct the deficiencies associated with fire alarm systems, a commercial-grade fire alarm system shall be installed with rate of rise heat detector zones, fire alarm strobes and bells and manual pull stations located throughout the primary tour route. The HFD will be providing response to fire emergencies at the B Reactor. A RFAR panel will be required to notify HFD in the event of fire alarm activation. Pyrotronics System III equipment, which is standard at all other Hanford facilities, shall be installed for uniformity of testing and maintenance activities performed by the HFD.

4.5 INDUSTRIAL AND RADIOLOGICAL SAFETY

A comprehensive walk-through and inspection of the B Reactor was performed to identify all current potential safety and radiological hazards that could pose a threat to persons participating in the primary tour route, even if the threat were not within the tour route itself.

The primary regulation for this portion of the radiological assessment was 10 *Code of Federal Regulations* (CFR) 835, even though much of the regulation is not applicable to the general public in a tour group setting. This regulation is intended primarily for occupational radiation protection; any radiation exposure to the general public on tours is not considered to be occupational exposure. However, 10 CFR 835.208, "Limits for Members of the Public Entering a Controlled Area," is applicable as a limit for ionizing radiation exposure to tour group members. In addition, it is assumed that tour guides may be volunteers and would also be governed by this limit.

While there is no specific regulatory requirement, it is recommended that best practices shall be to not allow untrained/unescorted members of the public to encounter actual radiological postings without some type of positive control measure, such as a locked door or gate, to preclude unauthorized entrance. There are a number of places where this situation exists, such as the front-face work area being posted as a "Fixed Contamination Area," or RBAs behind the display panels in the work area with only a rope and sign to keep the public from gaining access (Figure 4-7). Because in a tour configuration there could include small children, no unlocked access to any current or future radiological areas shall be allowed. It is recognized that while this may make access to such areas potentially more difficult for facility workers, it is in the DOE's best interest to adopt such a policy for a tour group setting.

It should be noted and recognized that the primary tour route has no elevated radiation levels, and the few locations where fixed contamination is present are protected by paint. Although there are no regulatory drivers for some of the radiological safety recommendations in this report, best practices that dictate above and beyond minimum regulatory compliance are the appropriate course of action and have been incorporated into the recommendations in this report.

In addition, the regulations contained in 29 CFR 1910 and 29 CFR 1926 were used as a guide for industrial hazard identification and mitigation. However, these regulations narrowly address occupational safety in the work place, and also do not address, for example, small children touring a facility that is a former nuclear reactor facility. Therefore, for some issues, local building codes were used to determine appropriate mitigative actions, such as for handrail requirements.

4.5.1 Industrial Safety

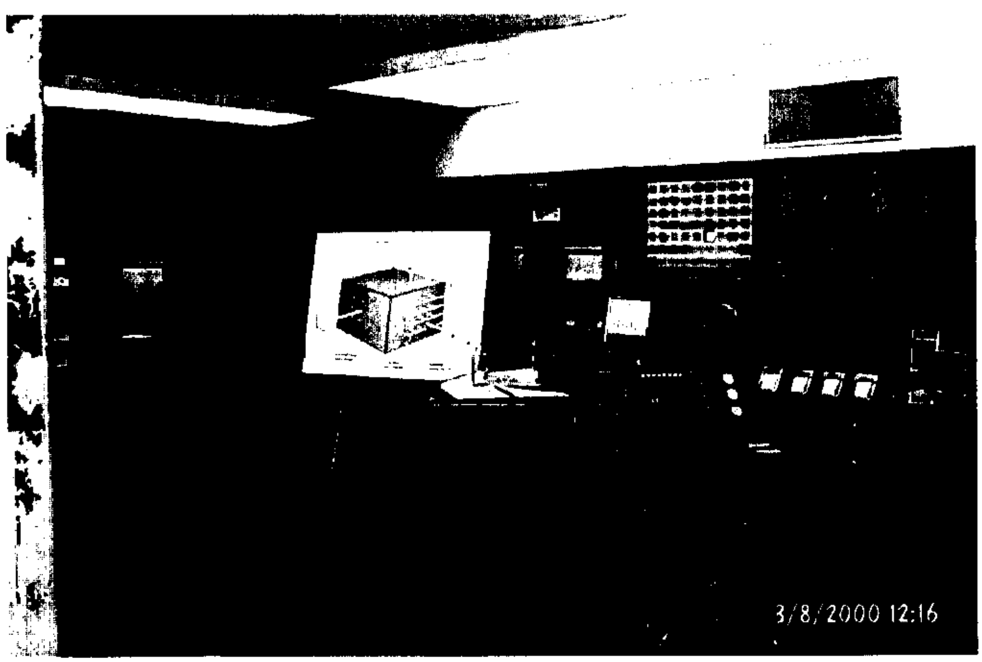
The industrial safety checklist included in Appendix A indicates the types of hazards that were considered during the walk-through and the general evaluation results after the walk-through. In addition to the industrial safety inspection and assessment, a gross inventory of ACM was undertaken. Samples were not obtained for asbestos analysis, but assumptions were made regarding such things as floor tile mastic and thermal system insulation. The results of the asbestos inventory for the primary tour route are presented in Section 4.5.1.1. It is recommended that no asbestos abatement is necessary.

The primary tour route is generally in good condition and free of serious safety hazards. There are no floor or wall openings, stairs, or handrails. Lighting is not adequate in all locations, as described in detail in Section 4.4.2.

While housekeeping in the primary tour route is adequate, there are significant spider webs and dirt throughout the overhead areas. The entire primary tour route, including overhead areas, should have a thorough cleaning performed and an appropriate ongoing S&M program established to support unescorted public tours.

It can be assumed that the majority of the paint throughout the facility contains lead. There are a number of areas, including in the control room (see Figure 4-10), where the paint is chipped and peeling. Following the cleaning, any area observed to have flaking or peeling paint shall be painted over with a high-quality, lead-free paint. Subsequent periodic inspections of the paint throughout the facility should be performed to maintain the integrity of the paint in the facility and preclude lead exposures.

Figure 4-10. Control Room.



There is evidence in many locations throughout the facility of bird and animal droppings. This material can carry diseases and shall be cleaned up. In addition, measures by S&M shall be taken to prevent, to the maximum extent possible, the entry of vermin into the facility. This will also help preclude the spread of radioactive contamination.

During the assessment, it was noted that rattlesnakes are often found near, and sometimes inside, the facility during certain times of the year. While there is no way to positively preclude animals from intruding, measures can be taken to help prevent potential problems. When tours are occurring in B Reactor, the facility, including the parking area, should be inspected every morning prior to allowing the public access to the area.

First aid supplies should be present when the facility is open for touring. No first aid kit or station was observed during the assessment.

4.5.1.1 Asbestos Inventory and Assessment. For the purposes of this inventory, all thermal system insulation (TSI) was assumed to be ACM, as well as all floor tile and floor tile mastic. Only ACM that is present in the primary tour route is addressed in this report. No ACM outside of this route was inventoried as a part of this assessment, as those areas are not accessible to the tour group members.

The ACM exists in B Reactor in three main forms. The TSI is plentiful as it was used extensively as insulation on piping systems. This material has been identified previously and is conspicuously marked with bright pink paint and labels (see Figure 4-11). In some locations, limited abatement has obviously been performed, but the majority of TSI still exists throughout the facility. If the material covering the TSI is cut or removed, the asbestos can easily become friable and present a hazard to the public.

Floor tile of the period found in the facility almost certainly contains asbestos, as does the mastic under the tile. Unless actions are taken that directly affect the integrity of the tile, such as sanding or grinding, this asbestos does not readily become friable.

Transite is a material that was used for walls or ceilings or as electrical insulation material in switchgear. As long as no work is done to cause the material to become broken, the asbestos does not readily become friable.

It is also probable that a large portion of the wire in the facility has asbestos-containing insulation. No attempt at an inventory of this ACM was made during this assessment because significant intrusive work would need to be performed to accomplish this task. As long as the wiring is not disturbed and is left inside conduits, switchgear, etc., no hazard exists due to its presence and no abatement effort is justified. This is also true for the material contained inside old fuse and breaker boxes. The inventory for asbestos in the primary tour area is provided below.

The TSI in the primary tour route is approximately 870 linear feet. The majority of this ACM is not accessible because it is in the overhead areas and out of reach. Of this total, there is approximately 30 linear feet, on three pipes, in the hallway between the control room and the front-face work area that would be readily accessible to the public. Protective jacketing shall be installed over existing coverings where ACM are present and in easy reach of tour guests. The ACM out of easy reach by tour guests does not require protective jacketing.

Figure 4-11. Work Area Entry Corridor.

The area of floor tile and mastic containing ACM is approximately 100 ft^2. The primary locations with floor tile are the control room and the two small offices, designated as Office A and Office B, which are adjacent to the control room. The tile is generally in good condition, and no abatement action is warranted at this time. There is one worn area with the underlying concrete visible, approximately 12 in. by 6 in., directly in front of the main control panel in the control room. This small area shall be sealed to prevent erosion and potential release of ACM.

The area of transite is approximately 150 ft^2. This transite is assumed to exist in the ceiling and walls of the control room.

An S&M program should be in place to provide for periodic inspections and maintenance to ensure that ACM is not breached and released to the environment.

4.5.2 Radiological Safety Assessment

For radiological safety, both external dose equivalent rates and surface contamination were considered. In the case of contamination, consideration was given to contamination on the primary tour route as well as the potential for the spread of contamination from non-tour areas into the tour route.

4.5.2.1 Radiation Issues. During the assessment, all areas of the primary tour route were assessed, and gamma-dose-equivalent rates were taken with a Bicron survey meter (instrument number B963E, last calibrated September 28, 1999). No dose rates above background were measured in accessible areas on the primary tour route. The highest dose equivalent rate measured in the primary tour route was 20 μrem/hr.

4.5.2.2 Contamination Issues. No areas or locations containing loose surface contamination were observed. (No surface contamination surveys were performed as a part of this assessment; however, the results of routine surveys conducted by BHI were examined.) In regards to fixed contamination and issues due to loose contamination off the primary tour route, the following observations were noted during the assessment:

- The control rod drive room directly above the control room is posted as a contamination area. This room and the stairway leading to it are not on the primary tour route. However, consideration should be given to decontaminating this room so that water cannot cause contamination to seep into the control room and/or out of the doorway and run into the primary tour route. There is evidence of water damage to the ceiling in the east portion of the control room. No mitigation is recommended in this report. However, S&M personnel should monitor this area during periodic inspections.

- Yellow and magenta tape, which usually indicate the potential or actual presence of radioactive material, were found on the sensing lines where they connect to the rod water drive pressure indicators in the control room. This area is behind one of the control panels where the public should not have access. During the assessment, the radiological control technician present for the assessment was notified. A survey was conducted and no contamination was detected. This tape should be removed, unless internal contamination is suspected and cannot be surveyed for release.

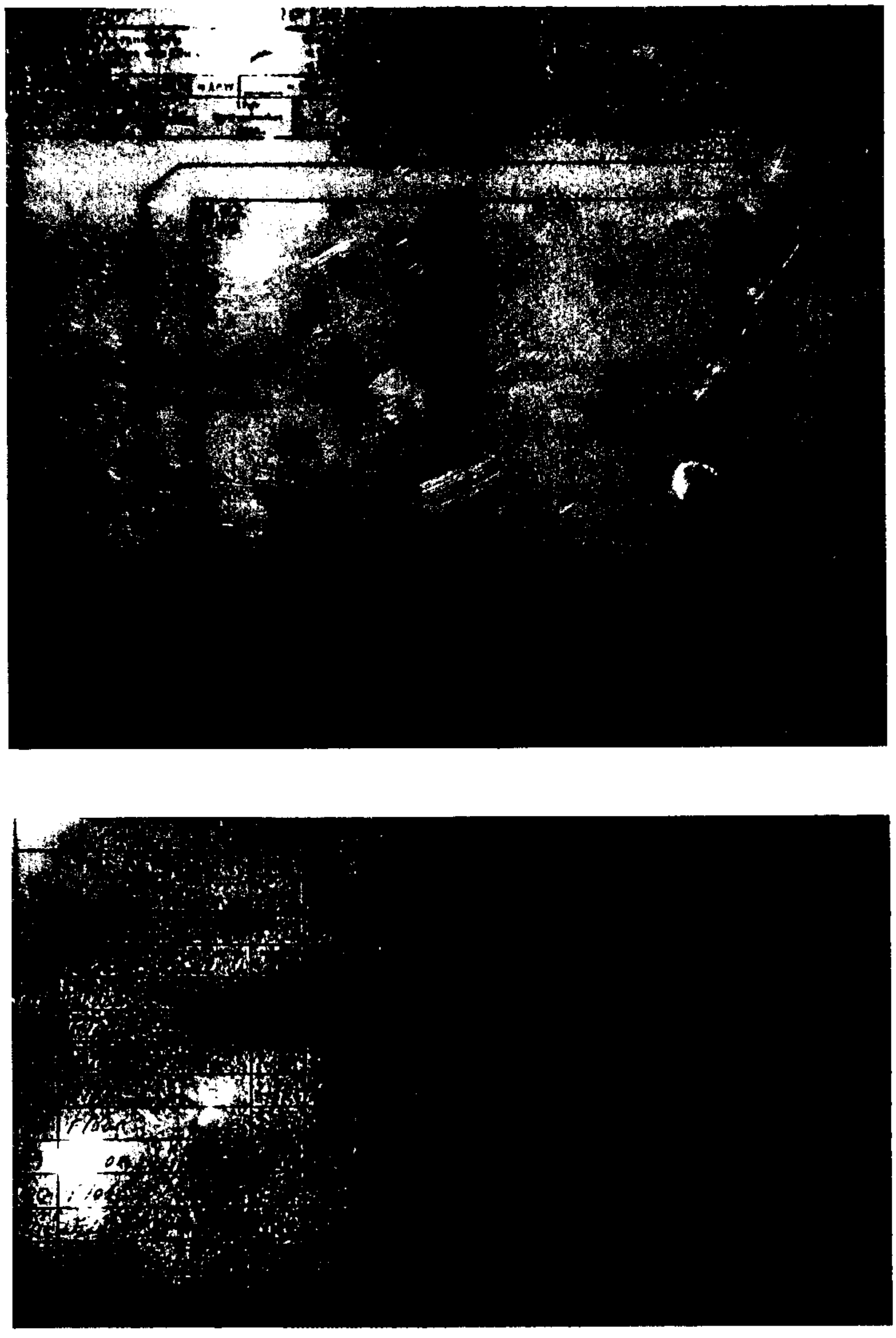
- At the entrance to the front-face work area, there is a sign on the floor stating, "CAUTION – FIXED CONTAMINATION AREA." Investigation revealed that a number (more than 25) of discrete spots of elevated fixed contamination exist on the floor in the work area. Figure 4-12 indicates typical measurement results from a radiological contamination survey conducted in the work area. The contamination has been painted over and locations are clearly marked on the Work Area floor. However, the potential exists for contamination to be liberated due to the paint being scratched, scuffed or chipped. The spots with fixed contamination shall be decontaminated to free release criteria so that the fixed contamination sign can be removed.

- There are currently, and therefore will be in the future, areas off of the tour route that contain loose contamination. The continuance of an ongoing routine radiological survey program under the auspices of DOE is important. A number of roof leaks could spread contamination into the tour route. In addition, there is existing evidence that birds and animals have gained access into the building. Animals are a threat to spread contamination throughout the facility and the primary tour route. It is recognized that it is not possible to prevent such intrusion into this facility. However, every attempt shall be made to minimize this possibility and provide for sufficient housekeeping and periodic radiological inspections to identify any spread of contamination.

4.5.2.3 Posting and Access Issues. The areas behind both sides of the display panels in the work area have ropes with RBA postings. Access into either one of these areas allows easy access to contamination areas and radiation areas in the reactor front-face work area and beyond. These accesses shall be eliminated by use of a positive control such as locked gates so no unauthorized entry is possible.

There is presently a "RADIATION DANGER ZONE" sign in the area of the reactor front face, just beyond and visible from the display area. Because this sign is no longer current under 10 CFR 835 and is most likely for display purposes, it shall be moved into the display area with a notation that it is for display purposes only. (In the present location, it potentially presents a bad impression to the public that a radiation danger zone is a few steps from where they are standing.)

Figure 4-12. Radiological Survey Locations and Results for Work Area (Typical).



A bundle of process tubes is hanging from the crane in the work area. The bundle is wrapped in plastic and has current radiological postings indicating that contamination is present inside the wrapping. Aside from the structural issue (see Section 4.2.5) of having these tubes above the tour route, the potential exists for water from roof leaks or other breaching mechanism to cause contamination to be spread into the tour route. The bundle shall be removed from the crane and each process tube will be inspected for radiological contamination. If possible, the tubes will be decontaminated to free-release criteria or otherwise documented as "clean" so the radiological posting can be removed. In the event that any process tube cannot be appropriately surveyed and released, the process tube will be disposed. Tubes that are surveyed and documented as not contaminated will be returned to the current location. If all tubes are found to be contaminated, noncontaminated tubes are available that will be used to replace the existing tubes for display purposes.

Access to RBA and contamination areas is possible from the primary tour area through a hallway leading east outside of the control room. A door or gate shall be erected in this hallway to prevent unauthorized access to these radiological areas.

4.5.2.4 As Low as Reasonably Achievable Evaluation. Three radiological conditions exist in the B Reactor that require consideration:

- Fixed contamination identified in the floor of the work area.
- Loose contamination associated with the reactor block and other areas not in the tour route that can be transported by water or animals to the tour route.
- Naturally occurring radon throughout the B Reactor. A discussion of these conditions and as low as reasonably achievable considerations is included in Appendix B.

4.6 FIRE HAZARD ANALYSIS

A comprehensive fire hazard analysis is included in Appendix C. This analysis followed the guidelines of HNF-PRO-350, Rev. 3, *Guidelines on Performance of Fire Hazard Analyses* (FDH 1999) and is provided so each necessary element of the assessment can be reviewed. Because fire hazards can exist in areas remote from the primary tour route, the walk-through was conducted in accessible areas throughout the facility. The fire hazard analysis, therefore, includes detailed discussions of areas beyond the primary route and is included as stand-alone documentation. Recommendations for mitigative actions determined by the assessment are primarily related to the occupancy and egress requirements and have been included in the main body of this report by the appropriate discipline that will generate the engineering design.

A fire hazard analysis that selected possible fire scenarios and their potential effect on the building and occupants is included in Section C.6 of Appendix C. An observation is made regarding a fire in the tool/storage room where there is not a rated fire separation between this room and the remainder of B Reactor. However, because conservative assumptions were used in this analysis, this area is not part of the primary tour route, other areas in B Reactor have similar construction, and because mitigative action would require significant altering of the existing structure, corrective action is not recommended at this time. If additional areas of B Reactor are opened for touring in the future, construction of a wall with a one-hour fire resistance rating and code-compliant doors should be considered.

4.7 SUMMARY

Table 4-2 summarizes the hazards and proposed corrective actions discussed in the previous sections. This table is designed to represent the most significant hazards and deficiencies observed. Further details are in the respective discussions.

Table 4-2. Hazards/Deficiencies and Corrective Actions. (3 pages)

Hazard/ Deficiency	Discussion	Corrective Action	Location
New egress pathway	Current egress from work area not sufficient according to FHA and UBC.	Establish escape route from the work area.	Provide for egress from work area through interior doors to exterior exit door west of lunch room.
Exit doors	Exit doors, hardware, and step-up pads not up to codes.	Provide working hardware, replace existing doors with replicas, provide for proper elevation changes and ADA requirements.	Exit doors (two on north side and one on west side).
New egress pathway	Interior sliding steel door leading to additional emergency exit not functional.	Secure door in open position.	Interior door on southeast side of valve room.
Exit signs	Exit signs not sufficient according to FHA and UBC.	Remove existing signs and replace with approved exit signs.	Install at locations to be designated.
Emergency lights	Emergency lights not properly located.	Replace lights behind displays in the front-face work area.	Install at locations to be designated.
Lighting	Less than requirements in some areas.	Add lighting to meet UBC requirements by refurbishing existing lighting where possible.	Work area, valve room escape corridor, control room hallway.
Lighting	PCBs potentially contained in ballasts.	Remove old ballasts and replace as necessary.	Control room.
New egress pathway	Grated floor.	Install cover.	Floor area in valve room egress pathway.
New egress pathway	Access to fan room, valve pit, and lunch room from new egress pathway.	Install barriers to prevent access by the public.	Egress pathway.
New egress pathway	Handrails not up to code.	Install intermediate handrails.	In valve pit room egress pathway.

Table 4-2. Hazards/Deficiencies and Corrective Actions. (3 pages)

Hazard/ Deficiency	Discussion	Corrective Action	Location
Access control	Barriers are necessary to prevent tour groups from entering certain areas.	Erect doors, plexiglass or other means to prevent access.	Area behind control panel; barriers at north and south corners of work area. Install plexiglass barriers to ancillary rooms at doorway.
Asbestos	Asbestos contained in piping, electrical components, tiles, and walls.	Asbestos generally is encapsulated and not a hazard.	Tile in control room; isolate two vertical pipes in corridor to Work Area.
Lead paint	Lead paint chipping.	Remove chipped paint and paint over.	Control room and small areas in tour route.
Fixed contam-ination	No current exposure; best practices suggest members of public shall not enter a radiologically controlled area.	Remove fixed contamination.	Work area - about twenty-five 1-ft^2 areas.
Loose contam-ination	No current exposure although potential exists from water and animals.	Provide for periodic surveys by S&M personnel.	Above control room; throughout tour area.
Radiological buffer areas	Areas shall not be accessible by public; currently signs and ropes are in place to prevent access.	Prevent access. Install plexiglass doors or barricades that allow viewing.	West of control room; behind displays south and north sides of work area.
Radiologic areas	Signs are misleading by being incorrectly placed or out of date.	Remove where appropriate and install current signs if needed.	All tour route areas.
Sanitation	No restroom facilities that meet ADA requirements.	Construct a stand alone, self-contained restroom facility.	Locate outside the reactor building.
Electrical	Reachable conduit, unknown energized systems, bare panels, etc.	De-energize existing system. Install new transformer for lighting, fans, receptacles, and heaters.	Propose transformer be placed near west egress exit. Provide receptacles for S&M activities.
Ventilation	Existing ventilation ducts provide pathway for water leakage.	Blank off any openings in the existing ventilation system. Recommend ductwork removal in the future replaced with a replica.	Areas in work area.
Ventilation	Elevated radon levels.	Install ventilation fan.	Locate ventilation fan through wall in work area.
Heat	No heat in tour areas so that interior surfaces are not maintained.	Provide electric unit heaters.	Locate in work room and hallway.
Ventilation	HVAC system not designed to code in control room.	Design new system to continue ventilation of radon.	Control room.

Table 4-2. Hazards/Deficiencies and Corrective Actions. (3 pages)

Hazard/ Deficiency	Discussion	Corrective Action	Location
CMUs	CMUs on outside of structure are deteriorating.	Ongoing maintenance activities shall include sealing.	Entire building.
Floor drains	Tripping hazard.	Remove drain and grout. Level to match surrounding surface area.	Primary tour area.
Roof panels	Panels in need of repair. General roof requires replacement.	Repair panels as needed. Continue with S&M roofing plan.	Entire building.
Overhead fall hazards	No immediate problems identified in primary tour route.	Continue with S&M roofing maintenance plan.	Entire building.
Overhead fall hazards	Suspended wrapped bundle is potential fall hazard. Radiologically contaminated.	Remove. Replace with non-contaminated process tubes. Provide dead man cable support.	Overhead, north side of work area.
Overhead fall hazard	Canvas drop shield integrity is unknown.	Provide dead man cable support.	Overhead, east side of work area.
Biological	Openings exist where birds and animals enter facility.	Seal openings during S&M maintenance.	Throughout tour route.
Housekeeping	General condition of tour route is not clean.	Paint portions of accessible areas in tour route.	Throughout tour route.
Fire	Fire extinguishers deficient in number.	Install five additional fire extinguishers.	Throughout tour route.
Fire	Fire alarm system deficient.	Install fire alarm system.	Building.
ADA	Parking lot not accessible.	Provide parking area upgrades (not in current scope).	Outside building.

FHA = fire hazard analysis
HVAC = heating, ventilation, and air conditioning

The engineering design drawings and associated cost estimates for the selected mitigative measures are included in Appendix D. All applicable codes and requirements have been incorporated in the designs and costs estimates. Assumptions are made regarding some minor details such as the total square footage of painting that is required and general repair of existing items based on observations made during the building walk-throughs. Quantities are indicated in the detailed estimate worksheets. A final site for the new restroom has not been established. However, there is sufficient space in the vicinity of B Reactor to site a parking area, restroom facility, and potential visitor center and other related infrastructure if the RL and BRMA reach a consensus on a location. The design in this report for the restroom facility includes allowances for extension of utilities that should be of sufficient length to accommodate most locations that may be selected.

The corrective actions are consistent with those derived by consensus between BRMA and RL upon review and comment of the 60% and 90% draft reports. The most significant comments related to retaining the historic character of B Reactor, where possible. These concerns are addressed in this report as follows:

- Doors requiring replacement will be replaced with custom-made replicas.
- The bundle rack of process tubes will be decontaminated, if possible, or replaced with available noncontaminated process tubes.
- The drop shield and bundle racks will remain in place and will be supported by new cables attached to the structure.
- Viewing of the restrooms and other rooms will be made possible.
- The steel-sliding door on the new egress corridor will be retained by permanently securing in the open position.
- The work area egress corridor will essentially become part of the primary tour route.
- All new components (e.g., ventilation fans and electrical transformers) will be located in visually unobtrusive locations.
- Lighting will be refurbished where possible and new lighting will replicate the older lighting.
- The location of the new restroom and parking facilities will be determined in the future by consensus.
- Corrective action for the roofing and ventilation ducting is a S&M responsibility. This will require further discussion and will not be included in the design package for this report.

Because the exposure duration and frequency to the public of any remaining minimal radiological and nonradiological constituents will be very small, no excessive risks are expected after the mitigative measures are completed. However, because of the nature of the facility, some potential hazards cannot be completely eliminated. For example, minimal risk is associated with spreading of radiological contamination by animals, ACM being breached, ballasts with PCBs leaking, and biological hazards associated with animals entering the facility. Therefore, it is essential that S&M procedures are in place to provide for routine maintenance, general housekeeping of the facility, and routine inspection for radiological and hazardous constituents within the tour route.

5.0 HEALTH AND SAFETY

The work performed will be conducted under the overall direction of BHI. A HASP and RWP will be prepared to address the safety and health hazards for the mitigative actions and specify the requirements and procedures for employee protection. Some of the work (e.g., radiological decontamination) will be performed by S&M personnel who are trained and perform work under current Hanford Site requirements.

5.1 PRELIMINARY HAZARD ANALYSIS

A preliminary hazard analysis overview is provided that indicates the major work tasks and the potential hazards expected that may affect employee protection. This preliminary hazard analysis includes an evaluation of the types of hazards associated with each major activity phase of the project. The process will facilitate work by identifying preliminary key hazards up front and incorporating risk.

Table 5-1. Preliminary Hazard Analysis Overview. (2 pages)

Major Work Tasks	Hazards	Causes	Preventive Measures
Perform radiological decontamination operations.	Exposure to radioactive materials internally and externally. Cell damage and damage to internal body organs can occur with acute overexposure to radioactive materials. Improper use of scabbling or other decontamination equipment can injure extremity or other limbs of workers by causing gash or cutting wounds.	Improper clean-up techniques including: Improper containment, decontamination or PPE usage. Improper ventilation usage. Improper waste disposal and handling. No or improper training in the proper use of decontamination equipment.	• Ensure all workers are trained as Rad Worker II. • Ensure all medical, equipment, training, and PPE requirements are met. • Ensure that proper radiological monitoring is performed. • Follow the RWP instructions, including ALARA review if required.
Deactivate existing electrical systems in the facility. Establish new electrical service and distribution system.	Electrical shock to body, cutting of extremities or body parts using wire strippers or other hand tools, falling off ladder or scaffolding, if used. Exposure to radiological contamination.	Lockout/tagout not used properly, all workers not informed of lockout/ tagout status. Improper use of hand tools, ladders or scaffolding. Improper lighting in room can cause improper use of equipment as well. Improper or no use of RWPs.	• Use lockout and tagout procedures properly. • Inspect all hand tools before use. • Ensure that all workers are trained in ladder, scaffolding, and fall protection measures before using this equipment. • Ensure that all worker training is current. • Adequate RWP developed and followed.

Table 5-1. Preliminary Hazard Analysis Overview. (2 pages)

Major Work Tasks	Hazards	Causes	Preventive Measures
Remove/replace doors. Install plexiglass in doorways.	Back injuries, pinching, and extremity damage by dropping or falling objects. Internal and external body injuries by vehicle impact. Eye injuries by poking or dust particles in eye. Noise hazards. Cutting hazards.	Improper lifting techniques, pre-job walkdowns not performed, lack of attention to detail, worker fatigue or no use or improper use of PPE.	• Use PPE properly. • Perform proper lifting techniques. • Do not attempt to move items that are stacked too high. • Cover all sharp edges with taping material. • Adequate RWP developed and followed.
Mitigate overhead falling dangers, i.e., bundle rack and drop shield. Secure bundle rack and drop shield to roof support structures in work area.	Bodily injuries due to falling objects or pinching of workers due to space limitations. Exposure to radiological contamination.	No rigging plan, improper rigging techniques, improper worker body positioning. Improper or no use of RWPs.	• Develop rigging plan. • Comply with standards for rigging. • Perform pre and post job inspections on all rigging equipment. • Ensure that all workers are properly trained. • Adequate RWP developed and followed.
Cut out openings for ventilation system.	Pinch points, foot and hand injuries, cutting of hands/arms, eye and head injuries, burning of skin or extremities. Exposure to radiological contamination.	Improper use of grinders or no guards on grinders, cramped working conditions, bad lighting, limited vision, improper use of PPE. Improper or no use of RWPs.	• Proper training with cutting equipment. • Use proper PPE. • Perform tooling inspections before each use. • Adequate RWP.
Construct and use scaffolding to perform job tasks.	Fall hazards, workers struck by failing objects, hand injuries. Exposure to radiological contamination.	No use of fall protection, improper training, no use of PPE, improper use of tooling, improper rigging and transport of scuffling pieces, no scaffold inspections, scaffold collapse. Improper or no use of RWPs.	• Proper training for scaffold erection and use. • Fall protection and rigging training. • Proper use of PPE. • Perform documented scaffolding inspections. • Ensure that all scaffolding is tagged properly. • Ensure that all toe boards and side rails are in place. • Adequate RWP developed and followed.

ALARA = as low as reasonably achievable
PPE = personal protective equipment

5.2 HAZARD ANALYSIS

The detailed approach to perform activities will be developed and approved in accordance with work plans. The work plan will contain detailed instructions for performing work onsite and contains specific controls and requirements to ensure protection of workers, the public, and the environment. Given the tasks identified in the specific work packages and consistent with the HASP, the work supervision and craft and industrial hygiene personnel will evaluate all work tasks for the potential to injure or damage personnel, property, or the environment.

6.0 HAZARDOUS MATERIALS MANAGEMENT

The waste generated by the project will be managed by properly trained personnel in accordance with state and Federal regulations.

The overall strategy for managing waste resulting from the mitigation of hazards in the primary tour route is to evaluate the generation and waste management on an area-specific basis. In general, waste materials will be sorted at the time of removal and prepared for further processing and packaging and transport to another area of the Hanford Site, away from the point of generation, and likely at the Environmental Restoration Disposal Facility (ERDF). The existing S&M procedures will be used as guidance to ensure the waste has been generated, packaged, and surveyed to meet the final disposal facility's waste acceptance criteria.

Waste types that will result from the mitigation of the primary tour route include radioactive, hazardous, toxic, and sanitary (i.e., industrial) waste. All waste generated as a result of activities will be managed in accordance with relevant Hanford Site waste operations procedures as guidance. Applicable Federal, state, local, and DOE requirements have been incorporated into the Hanford waste operations procedures.

7.0 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A preliminary list of potential applicable or relevant and appropriate requirements is included below. This list will be considered and modified by BHI as appropriate prior to performing the mitigative measures.

7.1 GENERAL CLEANUP CONSTRUCTION

The requirements for the control and/or prevention of the emission of air contaminants, including particulates are established in WAC 173-400. The code establishes acceptable source impact levels for more than 500 carcinogenic acutely toxic air pollutants.

7.1.1 Equipment and Waste Removal

The act of removing materials from the building to dispose of them will constitute waste generation. *Resource Conservation and Recovery Act of 1976* generator standards (40 CFR 262 and WAC 173-303-170) apply to dangerous waste generation. These include identification, packaging, labeling, and accumulation requirements. Dangerous waste removed from the facility must be disposed at a facility permitted to handle dangerous waste. The waste acceptance criteria of the receiving facility (likely the ERDF) are criteria to be considered in packaging, transporting, and/or treatment of waste prior to disposal.

7.1.2 Asbestos Management and Disposal

The *Toxic Substances Control Act of 1976* (TSCA), the Clean Air Act (40 CFR 61, Subpart M) and *Occupational Safety and Health Act* (29 CFR 1910.1101 and WAC 296-62) require the management and disposal of asbestos waste. These regulations provide for special precautions to prevent exposure of workers to airborne emissions of asbestos fibers during removal actions.

7.1.3 Polychlorinated Biphenyl Waste Removal

The TSCA and WAC 173-303 regulate the management and disposal of PCB and PCB waste. Implementing regulations in 40 CFR 761 contain requirements for the management and cleanup of materials suspected to contain PCB waste.

7.1.4 Radiation Protection

Federal radiation limits for occupational exposure are identified in 10 CFR 835. The State of Washington has established radiological standards for the protection of the general public (WAC 246-220). WAC 246-247 identifies requirements for controlling radioactive air emissions through the use of best available radionuclide control technology.

7.1.5 Solid Waste Handling

The minimum performance standards for the proper handling of all solid waste material are identified in WAC 173-304.

7.2 AMERICANS WITH DISABILITIES ACT

The ADA identifies requirements for accessibility to buildings for the disabled.

7.3 NATIONAL HISTORIC PRESERVATION ACT

The *National Historic Preservation Act* must be complied with before performing any action that would alter the existing configuration of the site.

7.4 TO BE CONSIDERED

The applicable DOE orders establish requirements relating to safety, health, and environmental protection. The substantive requirements of these standards will be met for S&M activities. Site and activity-specific requirements and controls will be identified in the final work plan documents. The following DOE orders have been determined to contain requirements that are pertinent to one or more of the mitigation activities:

- The requirement in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, for limiting exposure of the public to radioactive releases.
- The requirements in DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Waste*, to comply with U.S. Department of Transportation or equivalent packaging standards.
- Requirements in DOE Order 5480.7A, *Fire Protection*, to analyze and provide controls for fire hazards.
- Requirements in DOE Order 5480.20A, *Personnel Selection, Qualification, and Training.*

8.0 ENVIRONMENTAL CONSEQUENCES OF THE ACTION

The *National Environmental Policy Act of 1969* (NEPA) requires that actions conducted at the Hanford Site consider potential impacts to the environment. While no separate NEPA documentation is required for this effort, DOE policy requires DOE to consider environmental impacts of the proposed action and of alternatives as part of this report.

The proposed mitigation plans for the primary tour route involve dismantling activities such as disconnection of electrical power, removal and replacement of doors, installing ventilation fans, upgrading equipment, and minor decontamination.

Given the existing environmental and industrial setting of the B Reactor, environmental impact issues associated with the proposed activities are minimal. Activities are not anticipated to have direct or indirect, or irreversible and irretrievable impacts to natural resources at Hanford and ultimately will improve natural resources. The proposed activities are unlikely to result in any discernible adverse effects to biological resources, including vegetation, wetlands, wildlife habitat, and state or Federal sensitive (e.g., threatened or endangered) species populations or habitat.

9.0 QUALITY ASSURANCE

The MACTEC Quality Assurance Manager has the overall responsibility for the definition, development, and maintenance of quality assurance program documents, including the MACTEC quality assurance manual (MACTEC 1998), and project specific quality related documents. The Quality Assurance Manager reports directly to the regional Vice President and has complete independence associated with contract and project costs and schedules. The MACTEC Quality Assurance Manager provided the direction, oversight, and interpretation of quality requirements for the Phase II feasibility study.

An approved quality assurance program has been developed and approved that ensures compliance with 10 CFR 830.120, "Quality Assurance," DOE O 414.1A, *Quality Assurance Requirements*; and *Quality Assurance Requirements for Nuclear Facility Applications* (ASME 1994). The MACTEC Quality Assurance Program defines the policies, assigns responsibilities, and describes the program elements that affect the quality of products and services associated with this project.

Products are reviewed by the quality assurance organization, as required by the corporate quality assurance manual to ensure that applicable contractual requirements have been met and quality elements considered in the planning and development of these products. All design drawings and the overall report will be reviewed and approved by the Quality Assurance Manager.

10.0 STAKEHOLDER INVOLVEMENT AND RESPONSIVENESS SUMMARY

The participation of BRMA in the decision process was promoted by providing for review and comment on the Phase II assessment draft reports. Specifically, a meeting was held April 21, 2000, with BRMA and RL, with MACTEC support, to discuss mitigation selection presented in the 60% draft report. Consensus was generally achieved between BRMA and RL on the final mitigation selections. From these selections, engineering design drawings and associated costs were developed and were included in a 90% draft report. An additional opportunity to review and comment on the 90% report was provided to BRMA and RL in a meeting conducted June 5, 2000. Comments from this meeting are addressed within this final report where appropriate.

11.0 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 835, "Radiation Protection for Occupational Workers," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations*, as amended.

40 CFR 262, "Standards Applicable to Transporters of Hazardous Waste," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

Americans with Disabilities Act of 1990, 42 U.S.C. 12111, et seq.

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MACTEC, 2000, *Work Plan for the 105-B Reactor Museum Phase II Feasibility Assessment*, Rev. 0 MACTEC, Inc., Golden, Colorado.

National Historic Preservation Act of 1966, 16 U.S.C. 470, et seq.

NFPA 10, *Standard for Portable Fire Extinguishers*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 101, *Life Safety Code*, National Fire Protection Association, Quincy, Massachusetts.

Occupational Safety and Health Act of 1970, 42 U.S.C. 651, et seq.

Toxic Substances Control Act of 1976, 15 U.S.C. 2601, et seq.

UBC, 1997, *Uniform Building Code*, International Conference of Building Officials.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 246-222, "Radiation Protection – General Provisions," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended.

WAC 296-62, "Occupational Health Standards -- Safety Standards for Carcinogens," *Washington Administrative Code*, as amended.

WAC 51-9, "Washington State Historic Building Code," *Washington Administrative Code*, as amended.

WHC, 1993, *Risk Management Study for the Retired Hanford Site Facilities: Qualitative Risk Evaluation for the Retired Hanford Site Facilities*, WHC-EP-0619, Vol. 3, Westinghouse Hanford Company, Richland, Washington.

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WHC, 1994b, *105-B Damaged Roof Replacement*, Engineering Change Notice 600276, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

CHECKLIST AND CRITERIA FOR THE 105-B REACTOR WALK-THROUGH

Table A-1. Summary of Hazards Identified by Architectural/Engineering Assessments. (3 pages)

Discipline	Deficiency	Previous Recommendation	Mitigating or Corrective Measures Made to Date
Architectural	Paint is flaking and peeling on control panels in control room.	None.	None.
Architectural	Walls in front-face work area have black tar-like stains.	None.	None.
Architectural	Janitorial supplies are stocked on open shelves in Room 7.	None.	None.
Architectural	Display items can be picked up and carried off by visitors.	Fasten items down or set up barriers to prevent visitors from reaching items.	None.
Architectural	The elevation of the floor on either side of exit doors varies by more than 0.5 in.	None.	None.
Architectural	Built-up roofing has not been inspected to assess current condition.	Replace roofing during next maintenance cycle.	None, but reroofing project is in planning stage.
Architectural	Facility does not meet all accessibility requirements for disabled persons.	Evaluate requirement for additional emergency egress. Upgrade guard rails along tour route. Modify restroom to meet accessibility requirements. Alter displays and written information to be able to be seen by a seated person. Install signage to meet ADA.	None.
Electrical	Wireway covers are missing and wire ends are hanging out of wireway near entry to front-face work area.	Put wires back in wireways or cut off. Cover wireways.	Many covers have been reinstalled or wiring has been removed.
Electrical	Wiring is exposed in the communications panel in the control room.	Install metal or clear cover on panel.	None.
Electrical	Wireway on main control console in control room is open.	Put wires back in wireways or cut off. Cover wireways.	Many covers have been reinstalled or wiring has been removed.

Table A-1. Summary of Hazards Identified by Architectural/Engineering Assessments. (3 pages)

Discipline	Deficiency	Previous Recommendation	Mitigating or Corrective Measures Made to Date
Electrical	Rear door on control panel in control room is missing.	Install metal or clear cover on panel.	None.
Electrical	Door on electrical panel in control room is open.	Install metal or clear cover on panel.	Door has been closed.
Electrical	Temporary wiring is installed above the sink in the men's restroom.	Put wires back in wireways or cut off.	
Electrical	Visitors can come in contact with wiring bundles on back side of control panels in control room.	Barricade back side of control panels.	None.
Electrical	Lighting is poor throughout the facility.	Leave existing fixtures in place and add modern fixtures and lamps.	Fixtures have been relamped.
Electrical	Incandescent light fixtures have broken or missing lamps.	Leave existing fixtures in place and add modern fixtures and lamps.	Fixtures have been relamped.
Mechanical	Natural radon is not controlled due to lack of ventilation in the facility.	Install new permanent supply and exhaust fans to ventilate facility for a period prior to and during occupied hours. Install electric unit heaters in areas requiring freeze protection.	None.
Mechanical	Fire sprinkler systems in the front-face work area are not working.	Conduct fire hazards analysis in accordance with DOE Order 5480.7A. If fire sprinkler system is determined to be required, install system in tour areas.	None.
Mechanical	Sinks and toilets are extremely stained.	Clean and maintain fixtures.	Sinks have been cleaned but toilets have not.
Structural	Wood roof extending outward from north side of reactor shows signs of water damage in tool/storage area.	Make necessary repairs. Inspect condition periodically, every 6 months and after heavy rains or snow build-ups.	None.

Table A-1. Summary of Hazards Identified by Architectural/Engineering Assessments. (3 pages)

Discipline	Deficiency	Previous Recommendation	Mitigating or Corrective Measures Made to Date
Structural	Wood supported cover panels above front-face canvas drop shield is not secured adequately.	Secure panels in place or remove panels.	None.
Structural	Rolled up canvas drop shield support system may not operate properly.	Inspect support system on a regular basis to ensure safe operation.	None.
Structural	Concrete roof panels have minor cracks and some spalling and discoloration.	Assess overall structural adequacy of the roof. Inspect roof panels each year after snow/freezing temperature season and after any excessive build up of snow/ice/rain on roof.	None.
Structural	Concrete roof panels are damaged and deflected.	Several panels have been strengthened with reinforcing brackets.	No further measures beyond those already indicated have been taken.

ADA = *Americans with Disabilities Act*

Table A-2. Hanford B Reactor Museum Feasibility Assessment Checklist for Radiation and Industrial Safety. (3 pages)

Control Room and Adjoining Offices[a]	
Criteria	**Results/Measurements/Comments**
Walking surfaces – general requirements (Ref: 29 CFR 1910.22): • Housekeeping • Aisles • Floor loading – signs posted	• Floors generally in good shape with no tripping hazards noted. Aisles and access ways are adequate.
Walking surfaces – floor/wall openings (Ref: 29 CFR 1910.23): • Stairway floor openings – guarded • Ladder floor openings – guarded • Pits/sumps/manholes – guarded or covered • Wall openings – guarded if ≥4 ft drop • Platforms/runways – guarded • Railings/handrails – (record number of rails, height, room between rails) • Toeboards	• Not applicable to this area.
Stairs (Ref: 29 CFR 1910.24): • Measure stair width, rise, and tread run • Slip-resistant finish • Stair strength (>1,000 lb minimum) • Stairway platforms – same width as stairs and at least 30 in. in length of travel • Railings/handrails	• Not applicable to this area.
Means of egress (Ref: 29 CFR 1910.36, 37): • Number of exits • Units of exit width • Arrangement of exits • Access to exits • Exit signs for routes, exit doors, doors not an exit	• Four exits from control room exist: two hallways and through the two adjoining offices. No exits are marked.

Table A-2. Hanford B Reactor Museum Feasibility Assessment Checklist for Radiation and Industrial Safety. (3 pages)

Control Room and Adjoining Offices	
Criteria	**Results/Measurements/Comments**
Sanitation (Ref: 29 CFR 1910.141): • Vermin control/droppings • Potable water supply • Nonpotable water clearly marked • Toilet facilities – list number and type • Washing facilities – hot/cold running water, soap, drying facilities, record number and type	• No evidence of vermin was observed. • No potable water or sanitation facilities are currently available in the building.
Lighting – include lighting survey results on survey map	• Lighting varies from a low of 7 footcandles to over 100 footcandles, and is generally sufficient for public access purposes.
General housekeeping inspection	• Housekeeping in this area is generally good with no major problems noted. However, there is flaking paint, which likely contains lead, on the floor in various areas and flaking paint on various panels in the control room.
Hazardous materials inspection – Includes asbestos, oil, mercury, etc.	• The floor tile, as well as the mastic, most likely contains asbestos. It is in generally good shape, with only one bare spot noted directly in front of the main control panel. This spot, approximately 6 in. by 12 in., should be sealed to prevent further erosion of the tile. • The tile-like material on the ceiling and some wall areas may contain asbestos, although visual inspection indicates it is more likely a cellulose-based material. This material should be tested for asbestos; if it does contain asbestos, care should be taken to seal the few holes that are eroding in some places. Epoxy or paint can be used for this purpose. • There is a small mercury-filled thermometer on the east side of the central panel in the control room. Although the amount of mercury is small, it should be covered, perhaps with plexiglas, to prevent breakage. • The ballasts in the flourescent light fixtures likely contain polychlorinated biphenyls. However, unless they are found to be leaking (none were observed) it would likely be more cost effective to replace the light fixtures as they fail instead of a mass replacement effort throughout the facility.

Table A-2. Hanford B Reactor Museum Feasibility Assessment Checklist for Radiation and Industrial Safety. (3 pages)

Control Room and Adjoining Offices[a]	
Criteria	**Results/Measurements/Comments**
Radiological Safety – Include results on survey map: • Calculation of dose equivalent for tour group member • Warning signs/labels • Access/egress routes • Access to remaining radioactive material • Floor drains • Potential for future spread of contamination or change in radiological conditions	• Dose equivalent rates in the control room between 5 and 10 μrem/hr, which is considered to be background. No elevated readings were found. • During the inspection, the tubing to the nine rod water pressure indicators behind the west panel were found to have yellow and magenta tape on them, and four of the nine were disconnected. This likely indicates a past concern with possible contamination in these lines. (The tape appears to be quite old.) This was pointed out to the radiological control technician during the inspection. A survey was conducted and no contamination or elevated readings were detected. • The room directly above the control room, which houses the control rod drive mechanisms, is posted as a contamination area. If water were to leak through the roof into the contamination area, it could possibly leak into the control room, causing a spread of contamination; therefore, the room above the control room should be decontaminated to prevent this possibility.

a. This area is generally in good shape and safe for public access. The areas behind the control panels should be barricaded to prevent public access, as has already been done on the west panel. If this was done with plexiglas, the areas behind the panels could be lit to provide viewing. Because there is a possibility of energized equipment, mercury-containing components (none were observed during the inspection), and asbestos wire insulation, the public should not be allowed access behind any of the panels.

REFERENCES

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

Americans with Disabilities Act of 1990, 42 U.S.C. 1211, et seq.

DOE Order 5480.7A, *Fire Protection*, as amended, U.S. Department of Energy, Washington, D.C.

APPENDIX B

AS LOW AS REASONABLY ACHIEVABLE DOCUMENTATION

APPENDIX B

AS LOW AS REASONABLY ACHIEVABLE DOCUMENTATION

B.1 DISCUSSION

A formal as low as reasonably achievable (ALARA) evaluation is essentially a cost-benefit analysis where an individual or collective dose is present. One or more methods to reduce or eliminate the dose are considered with respect to the cost of the actions and the amount of dose reduction obtained. However, the highest dose-equivalent rate measured by the assessment team on the primary tour route is 20 µrem/hr (0.02 mrem/hr), which is considered to be background. No loose contamination has been identified in the primary tour route, and the fixed contamination does not currently pose a threat or contribute to a dose rate. Therefore, because there is no dose rate, an ALARA analysis will provide results suggesting that no mitigative action is warranted due to no cost benefit and increased potential exposure to workers with no measurable benefit of reducing exposures to the tour group.

Mitigative actions are recommended in this report as "best practices" to minimize potential exposures to tour group members. For example, it is recommended that the fixed contamination areas be removed, not only because of the potential for exposure, but primarily because it is inappropriate to have untrained, perhaps unescorted tour groups in a designated radiological area. The issue of loose contamination that can be transported by water or animals from contaminated areas to the uncontaminated tour route is more problematic. The contaminated area above the control room, because of its proximity to the tour route, is believed to be a greater potential hazard than contamination introduced from animals. Although the ceiling/floor separating the horizontal control rod room from the control room is a 2- to 3-ft-thick concrete slab, there is a potential for contamination to be spread through joints or through penetrations from ducting. The recommended method to control potential contamination spreading from the area above the control room and from animals is to provide for periodic inspection and measurements by S&M personnel.

B.2 RESULTS OF RADON MONITORING

B.2.1 Background

MACTEC Inc. placed six Radtrak™ radon monitors throughout the ground level of the B Reactor to measure current average concentrations of radon gas. These radon monitors utilize a track etch process to quantify radon gas. The manufacturer of the radon monitor completes the analysis of each detector and provides average radon concentration in picocuries per liter (pCi/L).

™ Radtrak is a registered trademark of Landauer, Inc., Glenwood, Illinois.

The detectors were placed on March 30, 2000, and were retrieved on April 27, 2000. Conditions in B Reactor during the measurement period were maximized so the building was closed and there was minimal air circulation. The building was opened during working hours on two or three occasions during the measurement period where some ventilation occurred. Following retrieval, the radon detectors were sent to the manufacturer for analysis.

B.2.2 Results

Results of the measurements were transmitted to MACTEC on May 19, 2000. The location where each detector was placed is summarized in Table B-1 and is noted in Figure B-1.

Table B-1. Radon Measurement Results.

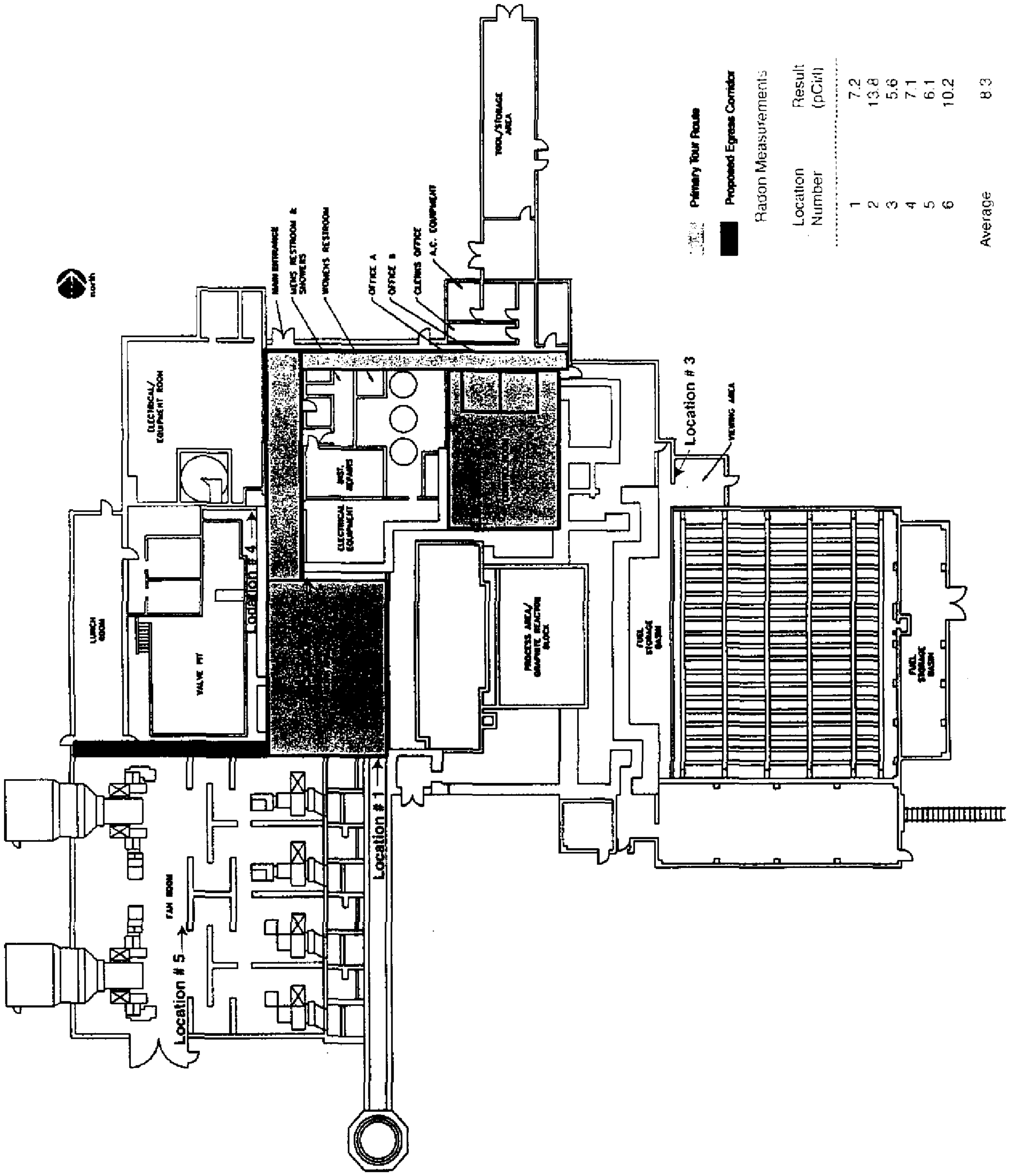
Detector No.	Location	Result (pCi/L)
4370909	Attached to electrical post; southeast corner of front-face work area (Location 1)	7.2
4370974	Attached to equipment behind control panel; west side of control room (Location 2)	13.8
4370955	Attached to equipment; inside viewing room (Location 3)	5.6
4370954	Attached to coat rack peg; just inside northeast door of valve pit area to hallway (Location 4)	7.1
4370920	Attached to coat rack peg; center area of fan room (Location 5)	6.1
4370922	Attached to pipe behind display panel; at entrance near the front-face work area from hallway (Location 6)	10.2

The results are relatively consistent from location to location, providing an overall average indoor radon concentration of 8.3 pCi/L, with a sample standard deviation of 3.1 pCi/L, for the period that was monitored. As these detectors were left in place for approximately one month, they provide a relatively accurate measurement of the average long-term radon concentration inside the facility without ventilation.

B.2.3 Mitigation

In *A Citizen's Guide to Radon* (EPA 1992), the U.S. Environmental Protection Agency (EPA) provides a level (action level) above which mitigation actions are recommended. It must be noted that the radon found inside the B Reactor facility is not considered by the U.S. Department of Energy (DOE) to be a source of occupational radiation exposure and is classified as background. (In the definition of "background" provided in 10 *Code of Federal Regulations* [CFR] 835.2, "Radon and its progeny in concentrations or levels existing in buildings or the environment which have not been elevated as a result of current or prior activities" is defined as background radiation that is not subject to the regulations contained in 10 CFR 835.) Therefore, because the radon concentrations are believed to be naturally occurring, no actual legal standard

Figure B-1. 105-B Reactor Radon Measurement Locations.



or limit is applicable for radon in the B Reactor. However, for the benefit of the general public who are participating in a tour, it is prudent to consider mitigation actions where radon levels exceed the EPA's action level, which is given as 4 pCi/L for indoor air. Although reduction of radon levels may also benefit potential staff members conducting tours who may occupy the building for up to 2,000 hr/yr, the reduction is not a regulatory requirement.

It should also be noted that the EPA's action level of 4 pCi/L is applicable to homes with continuous long-term occupancy. In the case of the B Reactor, there is no long-term occupancy, and the large majority of visitors will, in all likelihood, only visit one time and stay no more than 2 hours inside the facility. Therefore, a radon concentration much higher than 4 pCi/L in a tour configuration would be required to provide the same radiation dose equivalent to a person as that from continuous occupancy. Additionally, although any potential staff member would likely have more exposure than a tour member, it would be much less than in a home environment, and as stated above, is not considered occupational exposure.

The most appropriate and cost-effective mitigation measure to reduce the radon concentration in the B Reactor is installation of forced ventilation. The current practice is to open several doors for at least one hour prior to a tour group arriving at the facility to reduce the radon level. No accurate measurement has been made to determine how much this reduces the radon concentration; however, it has been recognized from secondary indications (e.g., reduced contamination of hard hats from radon progeny) that this passive ventilation is effective at reducing the radon concentration inside the B Reactor.

As a part of this report, it has been recommended that an exhaust fan with a capacity of 1,000 cubic feet per minute (cfm) be installed to provide a system of forced ventilation for the building. While the exact number of air exchanges per hour due to the installation of forced ventilation has not been calculated, it is believed that this forced ventilation will provide more than sufficient ventilation capacity to reduce the average indoor radon concentration in the tour route to less than 4 pCi/L.

B.2.4 As Low as Reasonably Achievable Evaluation

At an average indoor radon concentration of 8.3 pCi/L, with a one-time visit lasting a maximum of 2 hours, the calculated dose equivalent to a tour visitor due to indoor radon, if no radon mitigation is undertaken, is less than 1 mrem. As a formal ALARA evaluation is a cost-benefit analysis, no formal ALARA analysis is warranted for a dose equivalent of this small magnitude.

B.2.5 Recommendations

It is recommended that exhaust fans providing forced ventilation be installed in the work area. Additionally, the air conditioning system recommended for the control room should be installed for ventilation and climate control. Also, it is recommended that radon concentrations be measured at approximately the same locations after these actions are completed to quantify how much the radon concentrations are reduced.

APPENDIX C

FIRE HAZARD ANALYSIS

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SUMMARY

A fire hazard analysis (FHA) was performed for the B Reactor at the Department of Energy (DOE) Hanford Site. The scope of the FHA covers the entire B Reactor building, including the primary tour route, as well as other areas of the facility not included in this tour route. The analysis was conducted in accordance with RLID 5480.7, DOE Order 5480.7A, *Fire Protection, Guidance on Performance of Fire Hazard Analyses* (HNF-PRO-350, Rev. 3 [FDH 1999]), and WHC-SD-GN-FHA-30001, Rev. 0 (WHC 1994). The FHA addresses each of the 16 principle elements outlined in DOE Order 5480.7A, paragraph 9.a (3). The elements are addressed in terms of the fire protection objectives stated in paragraph 4 of DOE Order 5480.7A.

Objectives of this FHA are to determine (1) the fire hazards that expose the B Reactor, (2) the adequacy of the fire safety features currently located or planned for the facility, and (3) the degree of compliance of the facility with specific fire safety provisions in DOE orders, related engineering codes, and standards. The scope of this FHA includes the building construction, existing building fire protection, and site-wide fire protection.

The development of this FHA included a site visit to document the building layout and fire protection features and to obtain general site information. The site visit included a walk-through of the B Reactor building, discussions with fire protection and facility personnel, and a review of drawings and site plans/documents.

An analysis was then performed to establish candidate fire scenarios, evaluate the damage potential associated with these fires, and determine compliance with DOE fire protection requirements. The analyses involved reviewing existing requirements to qualitatively determine the potential impact of plausible fire scenarios on facility operations and safety.

Although this report addresses all required elements of a FHA, the analysis focused on the life safety of tour group members. In addition, this analysis is limited to the primary tour route (control room, the front-face work area, and adjacent corridors located on the ground floor

elevation) when considering the occupant load of the facility. Areas not on the primary tour route have been analyzed to the extent that they affect the safety of visitors.

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APPENDIX C

FIRE HAZARD ANALYSIS

C.1 INTRODUCTION

C.1.1 Background

The B Reactor, located in the 100-B Area of the Hanford Site, is one of nine plutonium-production reactors that was constructed in the 1940s. The B Reactor, which was the world's first full-scale production reactor, was placed on the National Register of Historic Places on April 3, 1992. The facility is currently operating as a controlled-access tour facility, with limited tours available upon request.

The primary tour route provides limited access to the control room, the front-face work area, and adjacent corridors located at the ground-floor elevation. In addition, various rooms that are not to be entered as part of the primary tour route will be configured with barriers so the interiors can be viewed from the hallways. These rooms include the old electrical/equipment room, the electrical equipment room, men's and women's restrooms, accumulator room, and the instrument repair room. In addition to the primary tour route, an egress pathway from the work area to the southwest exit of the lunch room will be established.

A number of areas in the B Reactor facility are not included as part of the primary tour route. These areas, which are not accessible by the general public, include the reactor block, valve pit, accumulator room, and fuel storage basin. In addition, all areas above or below the ground-floor elevation of the B Reactor facility are not included as part of the tour route and are not accessible by the general public.

C.1.2 Scope and Objectives

The scope of the fire hazard analysis (FHA) focuses on the areas of the B Reactor that are included in the primary tour route; however, other areas of the facility are also addressed in this analysis. The analysis was conducted in accordance with RLID 5480.7, U.S. Department of Energy (DOE) Order 5480.7A, *Fire Protection, Guidance on Performance of Fire Hazard Analyses* (HNF-PRO-350, Rev. 3 [FDH 1999]), and WHC-SD-GN-FHA-30001, Rev. 0 (WHC 1994). The FHA addresses each of the 16 principle elements outlined in DOE Order 5480.7A, paragraph 9.a (3). The elements are addressed in terms of the fire protection objectives stated in paragraph 4 of DOE Order 5480.7A.

This analysis was developed under contract with MACTEC, Inc., and was performed on behalf of Bechtel Hanford, Inc. (BHI). Objectives of this FHA are to determine (1) the fire hazards that expose the B Reactor, (2) the adequacy of the fire safety features currently located in the B Reactor, and (3) the degree of compliance with specific fire safety provisions in DOE orders, related engineering codes, and standards.

The results of the analyses are presented in terms of the fire hazards present, the potential extent of fire damage, the impact on employee and public safety, and the impact of the B Reactor's fire protection.

Figure C-1 depicts the general layout of the primary tour route floor elevation for the B Reactor building. Table C-1 provides details of rooms, doors, and corridors included on the primary tour route and other areas throughout the facility. The numbers of the rooms, doors, and corridors correspond to those shown on Figure C-1.

Table C-1. B Reactor - Room Descriptions. (3 pages)

Room Number[a]	Room Name	Description of Use/Contents
R1	Electrical equipment room	This space is currently empty but may be used for tour displays. The space contains carpeting rolled on the floor, metal cabinets, and a few displays. A suspended ceiling is located in this space. A plexiglass barrier will be placed at the entrance of this room so the interior of this room can be observed from the hallway as part of the primary tour route.
R2	Men's restroom	The men's restroom is not functional. A plexiglass barrier will be placed at the entrance of this room so this room can be observed from the hallway as part of the primary tour route.
R3	Janitor's closet	This room will not be observed from the hallway as part of the primary tour route. This room will be secured from access or viewing from the primary tour route.
R4	Women's restroom	The women's restroom is not functional. A plexiglass barrier will be placed at the entrance of this room so this room can be observed from the hallway as part of the primary tour route.
R5	Electrical equipment room	The following equipment is stored in this room: wooden electrical cabinets, wooden coat rack, and other electrical cabinets and equipment. A plexiglass barrier will be placed at the entrance of this room so this room can be observed from the hallway as part of the primary tour route.
R6	Valve pit	Grated walkways are provided above the valve pit. Valves located in the valve pit below were used to provide cooling water for the B Reactor. A corridor for egress from the work area will be established from Room D22 to Room D23. Barriers will be erected to prevent access to the perimeter of the valve pit. Room D23 will be established as an emergency exit. With the exception of the egress corridor, this area is not included in the primary tour route.
R7	Small room above valve pit	This room, located within the valve pit observation area, was used to store clothing for changeout. Nothing is currently being stored in this room. Room R8 is adjacent to this space. Gypsum wallboard is installed on the wall of this room. This room is not included in the primary tour route.

Table C-1. B Reactor - Room Descriptions. (3 pages)

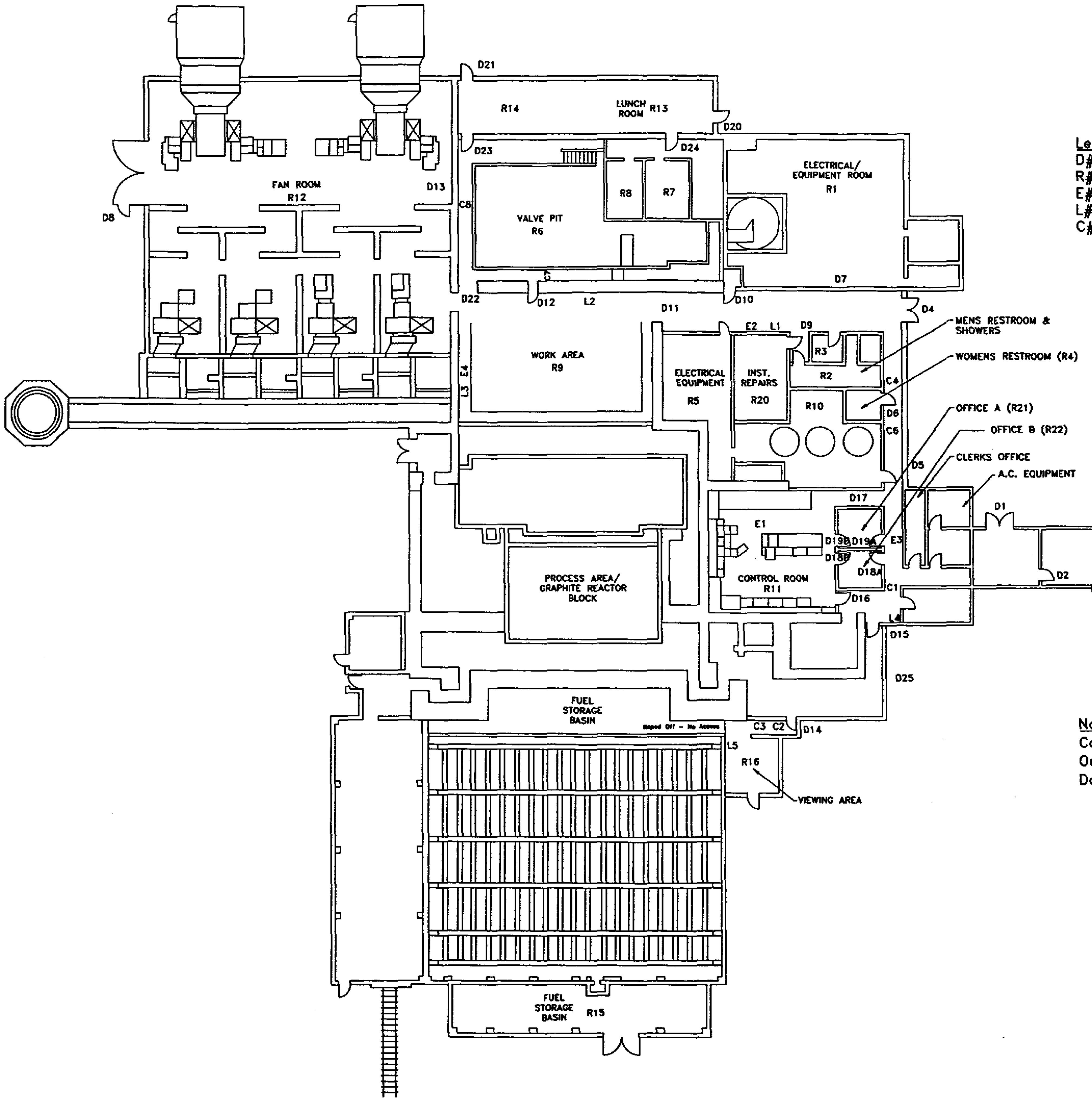
Room Number[a]	Room Name	Description of Use/Contents
R8	Small room above valve pit	This room has walls that are made of steel siding. Nothing is currently being stored in this space. This room is located within Room R6 and adjacent to Room R7. These rooms share a common wall with steel siding. This room is not included in the primary tour route.
R9	Front-face work area	Various displays are set up in this area. A large ventilation curtain is installed overhead and runs across the width of the room. Process tubes wrapped in plastic are installed overhead in this area, and run down the length of the room. This area is included in the primary tour route.
R10	Accumulator tank room	Equipment associated with the accumulator tanks is stored in this room. A staircase with wooden railings is located in this space. This room will be secured by plexiglass barriers. The stairs installed in this area are part of the radiological buffer area. This room can be observed from the hallway as part of the primary tour route.
R11	Control room	Heat detectors are installed in the control room. These detectors send a signal to the local panel; however, a signal is not sent to the fire department. Various equipment associated with reactor control is located in this area. Additional combustibles include a wooden ladder, file cabinets, and desks. Panels on the wall and on the ceiling in this area are fiberboard-type material. Notes in reports suggest that these tiles contain asbestos. The floor tile and mastic also likely contain asbestos. There are two office areas within the control room that contain wooden desks, cabinets, and tables. This room is included on the primary tour route.
R12	Fan room	The fan room can be accessed by walking through the area above the valve pit. Large fans and associated equipment are installed in this area. The main portion of this room is used to house building supply fans. Currently this area is part of a radiological buffer area. Fan cells are also located in this area. These cells house fan equipment used for exhaust air. Most equipment installed in this area is piping. Access to this room is secured. This room is not included in the primary tour route.
R13	Lunch room-north	There are two heaters installed in the lunch room. These heaters are operational. A wooden staircase located in this area leads to a space below. A large metal desk is also installed in this area. This room is not included in the primary tour route.
R14	Lunch room-south	This space is currently empty. A corridor is provided for egress from Room D23 to Room D21. This room is not included in the primary tour route.
R15	Fuel storage basin	The fuel storage basin is covered with fire-treated wood planks. Plywood sheets are placed over part of the wood planks to provide a path through this space. This room can be observed from the fuel storage basin viewing room (R16), which is not included in the primary tour route.

Table C-1. B Reactor - Room Descriptions. (3 pages)

Room Number[a]	Room Name	Description of Use/Contents
R16	Fuel storage basin viewing room	Three glass windows are installed in this area. These windows are provided for observation of the fuel storage basin. One windowpane was observed to be broken. Electrical panels are also present in this space. These panels have been roped off. This area is not included in the primary tour route.
R17	Contaminated areas (above ground level)	Most combustibles in this area include wooden staircase railings. In addition, two tool storage rooms were observed during the walk-through. Various tools and equipment were stored in these areas. One of the tool/storage rooms was observed to have a wooden roof deck. This area is not included as part of the primary tour route.
R18	Tool/storage area	The tool/storage area is a large wing of the building, located on the north end of the facility. This space is used to store various equipment including old lighting units that are stored on wooden pallets. Additional items stored in this area include concrete material stored on wooden pallets and wrapped in plastic and various equipment stored in wooden crates. Gypsum wallboard is installed on south wall of this room (to the west of door #2). The wall between the Tool/Storage Area and the rest of the building is separated by 0.5-in.-thick gypsum wallboard. Penetrations in this wall include sizeable gaps on the east side of the door. This area is not included as part of the primary tour route.
R19	Wooden sheds – outside	Three wooden sheds are located outside of the building. These sheds are currently empty and are not used for storage of materials. The wooden storage sheds are not included as part of primary tour route.
R20	Instrument repair	This room is currently vacant. A plexiglass barrier will be placed at the entrance of this room, so that this room can be observed from the hallway as part of the primary tour route.
R21	Office A	This room is an office space adjacent to the control room. This room is included on the primary tour route.
R22	Office B	This room is an office space adjacent to the control room. This room is included on the primary tour route.

[a] Room numbers listed, correspond to those shown in Figure C-1.

Figure C-1. 105-B Reactor Floor Plan (Current Condition).



Legend - Observed During Walkdowns
D# - Door Number
R# - Room Number
E# - Location of Extinguishers
L# - Location of Emergency Lights
C# - Corridor

Notes:
Contaminated Areas Above Ground Level (R17)
Outdoor Wooden Shed (R19)
Doorways in Main Corridor (C6)

C.1.3 Approach

The approach for the development of this FHA included a site visit to document the building layout and fire protection features and to obtain general information on the condition of the facility. The site visit included a walk-through of the B Reactor, discussions with personnel familiar with the facility, and a review of documents and plans.

An analysis was then performed to establish candidate fire scenarios, evaluate the damage potential associated with these fires, and determine compliance with DOE fire protection requirements. The analyses involved reviewing existing requirements to qualitatively determine the potential impact of plausible fire scenarios on facility operations and safety.

C.1.4 Assumptions and Limitations

The results of this FHA are based on the assumption that the types and quantities of combustibles observed during the walkdown and identified by personnel familiar with the facility are representative of the potential fire hazards in the B Reactor. Quantities and types of combustible materials significantly greater than those discussed in Section C.6 may invalidate the basis for determining the candidate fire scenarios and the potential impact presented in this FHA. Although worst-case conditions are generally considered in the FHA, the maximum possible fire loss (MPFL) fire scenarios evaluate a maximum quantity of combustibles, which shall not be exceeded without evaluation.

It is further assumed that the information provided in various site documents, drawings, and plans are accurate. This includes information provided by prior test results on fire protection systems, hydraulic data from water supply analyses, and construction features.

In keeping with sound engineering practice, in the absence of technical information, conservative worst-case assumptions are made regarding fuel loading, fuel package burning rates, fire spread, and thermophysical effects. In areas that were not accessible, facility personnel were interviewed to determine combustible loading.

An evaluation of the fire potentials of the hazards identified was performed to the extent that areas of the facility were accessible. For those areas that were not accessible, facility personnel were interviewed to determine combustible loading. It is assumed for purposes of this evaluation that the use of portions of the B Reactor as a tour area will be limited to the ground-floor elevation.

The B Reactor is currently being used as a limited-access tour area with controlled tours provided upon request. This analysis is limited to the primary tour route (i.e., control room, the front-face work area, and adjacent corridors located on the ground-floor elevation) when considering the occupant load of the facility as a tour area. Areas not on the primary tour route have been analyzed to the extent that they affect the safety of tour visitors. The addition of other areas to the tour route will require a re-evaluation.

C.1.5 DOE FHA Basis

Each of the FHA elements identified in DOE Order 5480.7A are addressed in this FHA. The elements of the FHA are identified in Table C-2.

Table C-2. Fire Hazard Analysis Elements.

Element (from DOE Order 5480.7A and Facility Staff)	FHA Report Section
Description of construction	C.3
Facility description and operations	C.4
Fire protection features	C.5
Description of fire hazards	C.6
Protection of essential safety class equipment	C.7
Life safety considerations	C.8
Critical process equipment	C.9
High-value property	C.10
Damage potential Maximum potential fire loss Maximum credible fire loss	C.11 C.11.1 C.11.2
Fire department/brigade response	C.12
Recovery potential	C.13
Potential for a toxicological, biological, and/or radiological incident due to a fire	C.14
Emergency planning	C.15
Security and safeguards considerations related to fire protection	C.16
Natural hazards impact on fire safety	C.17
Exposure fire potential	C.18

C.2 SUMMARY AND CONCLUSIONS

A primary concern related to the use of the B Reactor as a tour facility is the safety of the occupants from a fire protection standpoint. Numerous recommendations are made in this report to increase the level of safety to building occupants, including the installation of a fire detection and alarm system throughout the tour areas, upgrades to the means of egress, and the addition of emergency lighting and exit signs.

A recommendation is also made to administratively control the occupant load of the building so it does not exceed 200 people. This recommendation addresses the requirement to have automatic sprinkler protection throughout the ground floor of the building if the occupant load exceeds 300 people.

The MPFL for this facility is expected to exceed $1 million. This will require the installation of an automatic sprinkler system throughout the facility or a formal exemption request. A draft exemption request has been initiated by Hanford Fire Protection Engineering and should be completed.

Upon implementation of the recommendations in this report, an acceptable level of safety will be provided.

C.3 DESCRIPTION OF CONSTRUCTION

C.3.1 Fire Resistance/Construction Type

The building is constructed of a combination of poured concrete and concrete block walls. The roof is a cast-in-place concrete slab, 6.5 in. thick. For the purposes of this analysis the building construction type is classified as Type II-N in accordance with the Uniform Building Code (UBC). This type of construction is classified as Type II (000) in accordance with National Fire Protection Association (NFPA) 220.

C.3.2 Fire Areas/Separations

There are no fire-rated separations in this facility.

C.4 FACILITY DESCRIPTION AND OPERATIONS

C.4.1 Background

The B Reactor was constructed in 1943 and placed on the National Register of Historic Places in 1992 (Griffin et al. 1995). Preliminary steps have been taken to preserve the facility and plans to use portions of the B Reactor as a tour area are being considered. Currently the facility is being used as a limited-access tour area, with controlled tours of the facility provided upon request.

C.4.2 Primary Tour Route

The primary tour route through the B Reactor currently provides visitors with access to the large corridor adjacent to the front-face work area and also permits visitors to enter the work area of the reactor. The front-face work area contains several large displays, set up around the perimeter of the room. The primary tour route also includes access to the office areas adjacent to the control room. In addition, an egress route from the work area, through the southern portion of the valve pit room, to the southwest corner of the lunch room is recommended.

C.4.3 Additional Areas of the Facility

Other areas of the B Reactor will not be accessible by members of the public. These areas include portions of the facility located above or below the primary tour route floor elevation. Some rooms along the primary tour route will have provisions for viewing from doorways, but access will be prevented by plexiglass barricades. These areas will be off-limits to visitors and accessible only by the facility staff.

C.5 FIRE PROTECTION FEATURES

This section provides a general description of the active fire protection features at the B Reactor.

C.5.1 Fire Protection Water Supply

The water supply system at the Hanford Site consists of two underground main systems: raw and sanitary water. Water for fire protection purposes is provided by fire hydrants 18 and 19 located adjacent to the B Reactor through the sanitary water system. These hydrants are supplied through a 10-in.-diameter looped underground system.

The B Reactor could be serviced by two hydrants, which are supplied by the 10-in. pipe. Water flow test data for hydrants 17 and 19 (McKenna 2000) are summarized in Table C-3. These data can be used to determine pressure and flow for all other hydrants in the vicinity.

Table C-3. Hydrant Water Flow Test Results.

Hydrant	Static Pressure (psi)	Residual Pressure (psi)	Flow (gpm)
100B-17	84	76	1,150
100B-19	85	68	1,735

Fire Protection Design Criteria, DOE-STD-1066-99, (DOE 1999) contains certain mandatory requirements that were formerly in DOE Order 6430.1A, *General Design Criteria*. The following requirements apply to the B Reactor water supply:

- The fire hydrant system shall be capable of providing the flow rates established by the Uniform Fire Code (UFC) (1066-99, Section 6.1.2).
- Fire hydrant branches shall be no less than 6 in. in diameter and no longer than 300 ft (1066-99, Section 6.2.2).
- Hydrants shall be no more than 300 ft from the building/facility to be protected (1066-99, Section 6.2.5).

- Hydrants shall not be closer than 40 ft from the building (1066-99, Section 6.2.5).

There are five fire hydrants in close proximity to the B Reactor. Hydrant 2 is located approximately 400 ft to the northwest of B Reactor. Hydrant 18 is located approximately 50 ft to the south. Hydrant 19 is located approximately 50 ft from the northwest corner of the building. Hydrant 20 is located approximately 360 ft to the northeast. Hydrant 17 is located approximately 100 ft southwest.

The UFC (Appendix 111-A, Table A-111-A-1) (UFC 1997) establishes required fire flows based on the size of the fire area and the building construction. The construction classification of the B Reactor is Type II-N. The footprint of the building is approximately 260 ft by 225 ft (58,500 ft^2). These parameters would result in a minimum fire flow of 5,000 gallons per minute (gpm) at 20 pounds per square inch (psi). However, the layout of the facility is an irregular pattern and can be divided into four areas. Although these areas are technically not separated by fire rated barriers their substantial construction and the low fire loading provides an inherent level of compartmentation within the facility. On this basis, a conservative fire flow of between 3,000 to 5,000 gpm would be adequate.

The fire hydrant test results given in Table C-3 extrapolate to a fire flow of 3,535 gpm at 20 psi. The available system flow can be determined by analyzing the water supply data provided by the Hanford Fire Department on semi-logarithmic graph paper. This analysis results in a flow of approximately 3,600 gpm at 20 psi. From these data, it can be determined that the available system pressure and flow falls between the conservative requirement of 3,000 to 5,000 gpm.

C.5.2 Fire Suppression Systems

C.5.2.1 Automatic Fire Sprinkler System. There are no automatic sprinkler systems provided in the B Reactor.

C.5.2.2 Interior Standpipe Systems. There are no interior standpipe systems provided in the B Reactor.

C.5.2.3 Portable Fire Extinguishers. UL listed portable fire extinguishers are located in the B Reactor in the locations listed in Table C-4.

Table C-4. B Reactor Tour Area Fire Extinguisher Locations.

Extinguisher #[a]	Location
E1	In control room
E2	Outside of instrument repair room (R20)
E3	Outside of control room (about 88 in. from D5)
E4	In front-face work area (hidden behind displays)

[a] Extinguisher numbers listed correspond to those shown in Figure C-1.

Additional extinguishers shall be provided in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*, for protection of the tour areas (see Section C.19.1).

C.5.2.4 Special Hazard Suppression Systems. There are no special hazard suppression systems provided in the B Reactor.

C.5.3 Fire Detection and Alarm Systems

Four heat detectors are located in the control room. The detectors provide local alarm notification only and do not transmit a signal to the Hanford Fire Department (HFD). The calculated occupant load of the facility is 342 people (see Section C.8). NFPA 101, Section 8-3.4.1 requires a fire alarm system in an assembly occupancy with an occupant load greater than 300 people.

Activation of the fire alarm system shall be by manual-pull stations (NFPA 101, Section 8-3.4.2.1) unless smoke detection is provided throughout the facility (NFPA 101, Section 8-3.4.2.1, Exception No. 1) (see Section C.19.2).

C.6 FIRE HAZARDS

C.6.1 Introduction

The primary fire hazards within the B Reactor are identified and described in this section. The purpose of this section is to evaluate the primary fire hazards for their potential to (1) cause damage to the structure, (2) cause loss of building operations, (3) result in radiological contamination of large portions of the building, and (4) result in an uncontrolled release of radiological material to the environment.

Fire scenarios considered having the greatest potential for adverse impact on the structure, building operations, and/or radiological materials include the following:

- A fire in the tool/storage room
- A fire in the front-face work area
- A fire in the fuel storage basin
- A fire in the control room.

These scenarios were selected for analysis based on the building conditions observed during the walk-through.

C.6.2 Approach

Consistent with a graded approach, not all fire hazards are identified; only those that are considered to be a significant hazard or present an unusual threat are included in this analysis. It was conservatively assumed that ignition sources are present for all fire scenarios or that they could be introduced into the building by maintenance, repair, or other operations.

C.6.3 Fire Hazard Analysis Results

The results of the FHA are summarized in this section. Fuel-loading information is based on information gathered during the FHA walk-through and discussions with facility personnel. While possible ignition sources have been reduced or eliminated due to the deactivated state of the B Reactor, an ignition source was assumed available to evaluate the potential impact of the fire scenarios. This assumption is consistent with the basis of the FHA in which the consequences, as opposed to the overall risk, are assessed to determine the MPFL for the facility. Each fire scenario is described below and includes a compartment description, a description of the fire development, and a discussion regarding the extent of damage and the potential for radiological contamination spread. Recommendations/observations for improving the fire safety are made where considered appropriate.

C.6.3.1 Fire in the Tool/Storage Room. The tool/storage room (R18) is not separated from the rest of the facility by fire-rated construction. The wall separating the tool/storage room from the rest of the facility consists of a single layer of 0.5-in.-thick gypsum wallboard. The door in this wall is not a rated fire door. In addition, numerous unprotected openings exist in this wall.

The combustible loading in the tool/storage room is moderate, consisting of a few wooden pallets and a wooden crate, which is used to store equipment. A fire occurring in this area could develop undetected by persons occupying the tour areas. Given the size of the area, flashover conditions will likely develop, leading to full room involvement. The lack of a rated fire separation between the tool/storage room and the rest of the facility will enable the fire to propagate to other areas with extensive damage in the control room area (see Section C.19.3).

C.6.3.2 Fire in the Front-Face Work Area. The front-face work area is a 50-ft wide by 30-ft-long room with a 35-ft-high ceiling. The combustible loading in this area is limited primarily to the front face of the reactor and consists of displays (i.e., picture boards), plastic wrap, and various tour displays (e.g., mannequins with "period" anti-contamination clothing and tool displays). The displays are located around the north, east, and south walls of the room. The largest combustible fuel package in this area is the front face canvas spray shield that is suspended in front of the reactor core. In addition, Lexan (polycarbonate) shields are located across the front-face viewing area. Polycarbonate has a low rate of heat release and is somewhat difficult to ignite; however, it still represents a significant fuel load in the area.

Ignition sources in this area consist of electrical wiring providing power to lights and tour displays. Because of the size of the room and the combustible loading, flashover conditions are not anticipated. A fire originating in this area will not propagate to other areas of the facility. However, smoke damage in adjacent areas would likely result.

C.6.3.3 Fire in the Fuel Storage Basin. The combustible loading in the fuel storage basin consists of the plywood sheets that are used as walkways through the area. Additional material that was observed in this area included fire-retardant treated wood planks, piping and other related equipment, and the asphaltic emulsion placed on the basin walls and floor to fix radiological contamination during cleanup activities. The wood planking represents the largest concentration of combustible materials in the B Reactor.

Although ignition sources have been minimized, it is assumed that one is present. Due to the age of the planking the effectiveness of the fire-retardant treatment is assumed to be deteriorated. The wood planking would eventually burn and fall into the basin, thereby igniting the asphaltic fixative. The underlying contamination would be released into the atmosphere.

A fire originating in this area will not propagate to other areas of the facility. However, smoke damage and spread of radiological contamination in adjacent areas would likely result.

C.6.3.4 Fire in the Control Room. The control room, Office A, and Office B are provided with "period" furnishings to simulate conditions when the facility was operating. Other combustibles in this area include wood electrical cabinets and exposed wire insulation located behind and within control panels. Lexan (polycarbonate) shields used to prevent entry into certain areas will be installed in this area as well.

The only ignition source in the control room is facility lighting. All other sources of electrical power, including the control panels, will be de-energized. A fire originating in the control room will likely develop into flashover conditions. Although fire propagation to other areas of the reactor is unlikely, hazardous conditions will result in the corridor and other areas outside of and adjacent to the control room.

C.7 PROTECTION OF ESSENTIAL SAFETY-CLASS EQUIPMENT

Safety-class structures, systems, and components (SSCs) are defined as those engineered safety features that prevent or mitigate accidents that could result in unacceptable consequences to the public or onsite workers. The B Reactor is not an operating production facility and, therefore, does not contain any safety-class SSCs.

C.8 LIFE SAFETY CONSIDERATIONS

C.8.1 Occupancy Type and Expected Occupant Load

The B Reactor is classified according to a specific occupancy type as defined by NFPA 101, *Life Safety Code*. On the basis of the anticipated use of the B Reactor tour area, the classification of this space is defined as a new assembly occupancy. To meet the requirements of the code, this facility must meet the requirements of Chapter 8 of NFPA 101.

This analysis of the use of the B Reactor is limited to the primary tour route (including the front-face work area, control room, etc.). The inclusion of other areas that may be opened for tours in the future (including the valve pit area, storage basin viewing area, etc.) will require a re-evaluation. Other areas of the B Reactor are not accessible by the general public (including the fuel storage basin, accumulator rooms, and the upper elevations of the reactor block). There are currently no plans to add areas located above the level of exit discharge to the tour route.

In determining the occupant load of this facility, only the primary tour area was included. An occupant load factor of 15 net ft^2/person was selected to determine the occupant load. Table C-5 details the expected occupant loads for the tour route areas.

Table C-5. B Reactor Tour Area Occupant Load.

Room #	Description of Room/Space	Area of Space (ft^2)	Occupant Load Factor (ft^2/person)	Occupant Load (people)
R11	Control room	650	15	44
R11	Offices	250	15	17
R9	Front face work area	2,200	15	147
	Circulation/other	2,000	15	134
	Total:	5,100	15	342

The calculated occupant load determined for the primary tour route area is 342 people. This is the minimum number of people for which adequate egress facilities must be provided. However, consideration shall be given to administratively controlling the occupant load of the facility (see Sections C.19.4 and C.19.10).

C.8.2 Means of Egress

Currently there are two accessible doors in the B Reactor tour area that are unlocked and adequate in width to provide means of egress for the building occupants. Doors D4 and D5 were determined to be accessible as they were unlocked during walk-throughs, and additionally, were provided with exit signs. These doors shall be kept open while the building is occupied.
Table C-6 provides a list of the doors that are part of the primary tour route and egress route. Doors that can be used as a means of egress to the outside and their accessibility conditions, as noted during walk-throughs (i.e., accessible, locked, blocked, or sealed) are indicated.

Table C-6. Doors on Primary Tour and Egress Routes.

Door[a]	Location	Clear Width	Exit to Outside	Conditions
D4	In hallway near electrical equipment room	35 in.	Yes	Accessible
D5	Door we used to enter/exit building	34.5 in.	Yes	Accessible
D10	Door to valve pit area	34.5 in.	No	N/A
D11	Doors to work area	87 in.	No	N/A
D12	Door in work area to valve pit	36 in.	No	N/A
D13	Doors to fan room	43.5 in.	No	N/A
D16	Door to control room	47 in.	No	N/A
D17	Door to control room	34.5 in.	No	N/A
D18A	Door into control room office	32 in.	No	N/A
D18B	Door into control room	31.5 in.	No	N/A
D19A	Door into control room office	32 in.	No	N/A
D19B	Door into control room	31.5 in.	No	N/A
D21	Door in lunch room	34.5 in.	Yes	Locked
D22	Rolling door in work area	73 in. – width of door	No	Closed during walk-throughs
D23	Door from valve pit to lunch room	34.5 in.	No	N/A

[a] Door numbers listed correspond to those shown in Figure C-1.

C.8.3 Exit Capacity

The *Life Safety Code* (NFPA 101) mandates that all structures provide a minimum amount of exit capacity as a function of the actual maximum anticipated occupancy (number of people). To ensure adequate exiting ability, the code establishes minimums based on the occupied areas of the building (primary tour route). Tables C-7 and C-8 provide details on the existing doors and corridors serving the B Reactor.

Table C-5 lists the occupant loads for the primary tour route. Using an egress factor of 0.2 in. per person for level components, the exits currently used (D4 and D5) have a capacity of approximately 345 people. Although this capacity is adequate for the anticipated occupant load these doors do not meet *Life Safety Code* requirements for common path of travel (NFPA 101, Section 8-2.5.1) or remoteness of exits (NFPA 101, Section 5-5.1.4). Therefore, additional exit doors are required (see Section C.19.5).

Table C-7. B Reactor Tour Area - Door Information. (2 pages)

Door[a]	Location	Clear Width	Comments/Description
D1	Near tool/storage area (R18)	87 in.	Double set of wooden doors. No door handles are provided; push door to open. No panic hardware is installed. Currently the doors are locked from the outside. In addition, slide bolt locks are provided at the top and bottom of the door on the right-hand side.
D2	Door to tool/storage area (R18)	34 in.	Single door installed. An exit sign is provided to the left of the door; however, there are no exits to the outside from this space. All doors in the storage area are sealed closed.
D3	In north end of tool/storage area (R18)	85.5 in.	Double wooden door provided in the rear of the storage area. This door exits to the outside; however, the door is currently sealed closed.
D4	In hallway near electrical/ equipment room (R1)	35 in.	Single personnel door installed in a set of double sliding doors. The door handle on the personnel door was noted to be damaged. This exit requires a 6-in. step-over.
D5	Door near control room (R11)	34.5 in.	Main entrance door. The door is provided with a Yale door closer, panic bar and wired glass. This door exits to the outside and requires a small step up, approximately -4½ in.
D6	Women's restroom (R4)	34.5 in.	Wooden door.
D7	Electrical/equipment room (R1)	35 in.	Wooden door and frame.
D8	Rear door in fan room (R12)	30 in.	A single personnel door is installed in a rolling door. The personnel door exits to outside; however, the door is currently sealed closed.
D9	Men's restroom (R2)	28 in.	Wooden door.
D10	Door to valve pit area (R6)	34.5 in.	Wooden door with a small window (11 in. by 9 in.). The door is provided with a Yale door closer.
D11	Doors to work area (R9)	87 in.	Double set of metal doors. The left-hand side door is provided with a panic bar. Door is left open for the tour.
D12	Door in work area (R9) to valve pit (R6)	36 in.	A single wooden door with a wooden frame. The door is currently blocked (on the front face work area side) by an aluminum process tube, a horizontal rod, and a vertical safety rod.
D13	Doors to fan room (R12)	43.5 in.	A set of wooden sliding doors. These doors lead from the valve pit to the fan room.
D14	Door to storage basin viewing area (R16)	35 in.	A single wooden door with a steel plate on the lower half and a small window (9 in. by 9 in.).
D15	Door to cushion corridor	34.5 in.	A single wooden door with a padlock.

Table C-7. B Reactor Tour Area - Door Information. (2 pages)

Door[a]	Location	Clear Width	Comments/Description
D16	Door to control room (R11)	47 in.	A single wooden door with a small window and a Yale door closer. The door handle is approximately 47 in. above the floor.
D17	Door to control room (R11)	34.5 in.	A single wooden door with wired glass panel (24 in. by 36 in.). A slide lock is provided on the control room side of the door.
D18A	Door into control room, Office A (R21)	32 in.	A single wooden door.
D18B	Door into control room (R11), exiting R21	31.5 in.	A single wooden door.
D19A	Door into control room, Office B (R22) from hallway	32 in.	A single wooden door.
D19B	Door into control room (R11), exiting R22	31.5 in.	A single wooden door.
D20	Door in north lunch room	34.5 in.	A single door with wired glass and a Yale door closer. The door closer was observed to be damaged. This door was locked during the walk-through. Panic hardware is installed. Exiting through this door may require a step-down (however, this was not verified because this door was locked during the walk-through).
D21	Door in south lunch room	34.5 in.	A single door. This door is currently inoperable (sealed closed). Panic hardware is installed. Exiting through this door may require a step down (however, this was not verified because this door was locked during the walk-through).
D22	Rolling door in work area (R9)	73 in. – width of door	This door is currently inoperable, as the door is closed and roped off on the work area side. Because this door was closed during walk-throughs, the exact width of the opening could not be determined.
D23	Door from valve pit (R6) to south lunch room	34.5 in.	A single wooden door. The door is provided with a door closer. The door was observed to be missing a glass pane, 27 in. by 20.5 in. The door handle appears to be damaged.
D24	Door to north lunch room from valve pit (R6)	34.5 in.	A single wooden door. A door closer and a wired glass pane are also provided.
D25	Door near cushion corridor	34.5 in.	A single door. This door is currently inoperable as it was observed to be sealed closed.

[a] Door numbers listed correspond to those shown in Figure C-1.

Table C-8. B Reactor Tour Area - Corridor Information.

Corridor #[a]	Description	Clear Width
C1	"Doorway" to cushion corridor	36 in.
C2	Cushion corridor – after passing through door d15	49 in.
C3	Cushion corridor – from wall to large diameter pipe	36 in.
C4	Main corridor outside of control room	56.5 in.
C5	"Doorways" in main corridor	36 in.
C6	Main corridor from wall to column	48.5 in.
C7	Access way above valve pit – grated area, from work area/corridor	43 in.
C8	Access way above valve pit – outside of fan room	69 in.

[a] Corridor numbers listed correspond to those shown in Figure C-1.

C.8.4 Number of Means of Egress

Section 5-4.1.1 of the *Life Safety Code* (NFPA 101) requires two means of egress from any balcony, mezzanine or story. The code requires that these exits be remotely located from one another. Currently doors D4 and D5 serve as the means of egress for the tour area. These doors do not meet the requirements of NFPA 101. As discussed in Section 8.3, an additional exit is required to be made accessible (see Section C.19.5).

C.8.5 Arrangement of Means of Egress

Sections 8-2.5.1 and 5-4.1.1 of the *Life Safety Code* (NFPA 101) require exits to be remotely located from each other and arranged to minimize the possibility that they might be blocked by any emergency. The exception to this paragraph allows a common path of travel for the first 75 ft from any point where serving not more than 50 occupants. Currently only doors D4 and D5 serve as exits from the facility. These doors are not remotely located from each other as defined by NFPA 101, Section 5-5. Therefore, an additional exit door is required (see Section C.19.5).

The front-face work area has an occupant load of approximately 147 people. The common path of travel permitted is 20 ft in accordance with Section 8-2.5.1 of NFPA 101. The common path of travel from this area is in excess of 20 ft. Therefore, an additional means of egress from the front-face work area is required. Door D22 is located in the front-face work area and provides access to the walkway above the valve pit area. Door D22 was observed to be inaccessible during walk-throughs, as the area near this door was roped off and the door was difficult to open. Egress through this door shall be made possible so that occupants in the work area may exit through the D22 entry into the area above the valve pit and through D23 into room R14, lunch room. Currently there are no additional exit doors that are accessible from the lunch room. Therefore, an additional door (that exits to the outside) is required to be made accessible. It is recommended that door D21 be made accessible and remain unlocked while the building is occupied (see Section C.19.5).

C.8.6 Travel Distance

To ensure prompt access to exits, the *Life Safety Code* (NFPA 101) specifies a maximum allowable distance persons are permitted to travel before reaching an exit. Section 8-2.6.1 of NFPA 101 limits the travel distance to 150 ft for unsprinklered assembly occupancies. This travel distance is not exceeded for areas that are included as part of the primary tour route.

C.8.7 Emergency Lighting and Exit Signs

During walk-throughs emergency lights were observed to have been provided in the locations identified in Table C-9.

Table C-9. B Reactor - Emergency Light Locations.

Emergency Light #[a]	Location
L1	Outside of instrument repair room (R20)
L2	In front-face work area
L3	Two sets of lights behind displays in front-face work area
L4	Adjacent to D15 – in cushion corridor
L5	In viewing room, adjacent to fuel basin windows

[a] Emergency light numbers listed correspond to those shown in Figure C-1.

No additional emergency lighting units were observed in the primary tour area. Three emergency lighting units were provided in the front-face work area, two of which were located behind the display area running along the south wall. These emergency lights were hidden by the display equipment and were marked "OUT OF SERVICE." The operability of these lights shall be determined. If these lights are determined to be operational, they shall be relocated so they are not blocked by the equipment in the area (see Section C.19.6). In addition, emergency lights are required to be installed in any area of the tour area that has been determined to be part of a means of egress (see Section 19.6).

Exits are required to be marked in accordance with the requirements of Sections 5-10 and 8-2.10 of the *Life Safety Code* (NFPA 101). Exit signs are currently provided at various locations throughout the facility, and the locations of these signs are described in Table C-10.

Table C-10. B Reactor Tour Area - Exit Sign Locations.

Exit Sign #	Location	Description
X1	Points toward door D5. Main corridor outside of control room.	Plastic sign with directional arrow, pointing in direction of D5. White sign with green lettering.
X2	Sign near storage area, adjacent to door D2. This sign shall be removed – no exit to outside through storage area.	Plastic sign. White sign with green lettering.
X3	Sign near door D5. Main corridor outside of control room.	Plastic sign. White sign with green lettering.
X4	Exit sign on door D4.	Plastic sign with directional arrow. White sign with green lettering.
X5	Exit sign adjacent to door D5.	Plastic sign. White sign with green lettering.
X6	Exit sign on door D5. Sign located on wired glass of door.	Plastic sign. White sign with green lettering.
X7	Exit sign in cushion corridor.	Paper sign. White sign with black lettering. Points to D5.
X8	Exit sign in cushion corridor.	Paper sign. White sign with black lettering. Points to D5
X9	Exit sign near cushion corridor.	Plastic sign with directional arrow. Points to D5.

The exit signs currently installed in the B Reactor do not meet the requirements detailed in Section 5-10 of NFPA 101. The following summarizes the requirements of NFPA 101 that are not met by the exit signs currently installed:

- <u>Section 5-10.1.2</u> – Requires approved exit signs to be readily visible from all directions of exit access. Exit signs installed throughout the facility do not meet these requirements.

- <u>Section 5-10.1.4</u> – Requires exit signs to be placed so that no point in exit access is greater than 100 ft from the nearest visible sign.

- <u>Section 5-10.2</u> – Specifies requirements for size of signs and lettering. The paper exit signs provided in the cushion corridor do not meet these requirements.

- <u>Section 5-10.3.1</u> – Requires that exit signs be illuminated by a reliable light source. Exit signs may be internally or externally illuminated. Exit signs installed throughout the facility do not meet these requirements.

- Section 5-10.4.1 – Requires exit signs to be provided with directional indicators when the direction of travel to the nearest exit is not obvious.

The exit signs currently installed throughout the facility shall be replaced with exit signs meeting the requirements in Section 5-10 of NFPA 101. Additional exit signs that meet the requirements of Section 5-10 in NFPA 101 shall be provided in these areas and near doors that are used as exits (see Section C.19.7).

C.8.8 Interior Finish

The interior finish in assembly occupancies is required to have a maximum flame spread rating of 25 in enclosed stairways, 75 in all corridors and lobbies, and 200 in assembly areas with an occupant load of less than 300 people.

All areas are required to have a maximum smoke developed rating of 450. The U.S. Department of Energy, Richland Operations Office (RL) (RLID 5480.7, Section 8.2.e) stipulates more restrictive criteria for interior finish in nuclear facilities and laboratories; however, these requirements are not applicable because this space is no longer an operating nuclear facility.

The interior finish in the B Reactor consists mainly of concrete and vinyl tile floors and painted concrete block walls and complies with the requirements of the *Life Safety Code* (NFPA 101).

C.8.9 Miscellaneous Means of Egress/Exit Improvements

There are a number of improvements that are required so the means of egress and exits meet the requirements of the *Life Safety Code* (NFPA 101). Figure C-1 indicates the locations of exit doors, exit signs and emergency lights that are recommended to meet the requirements of NFPA 101. The following is a list of required improvements:

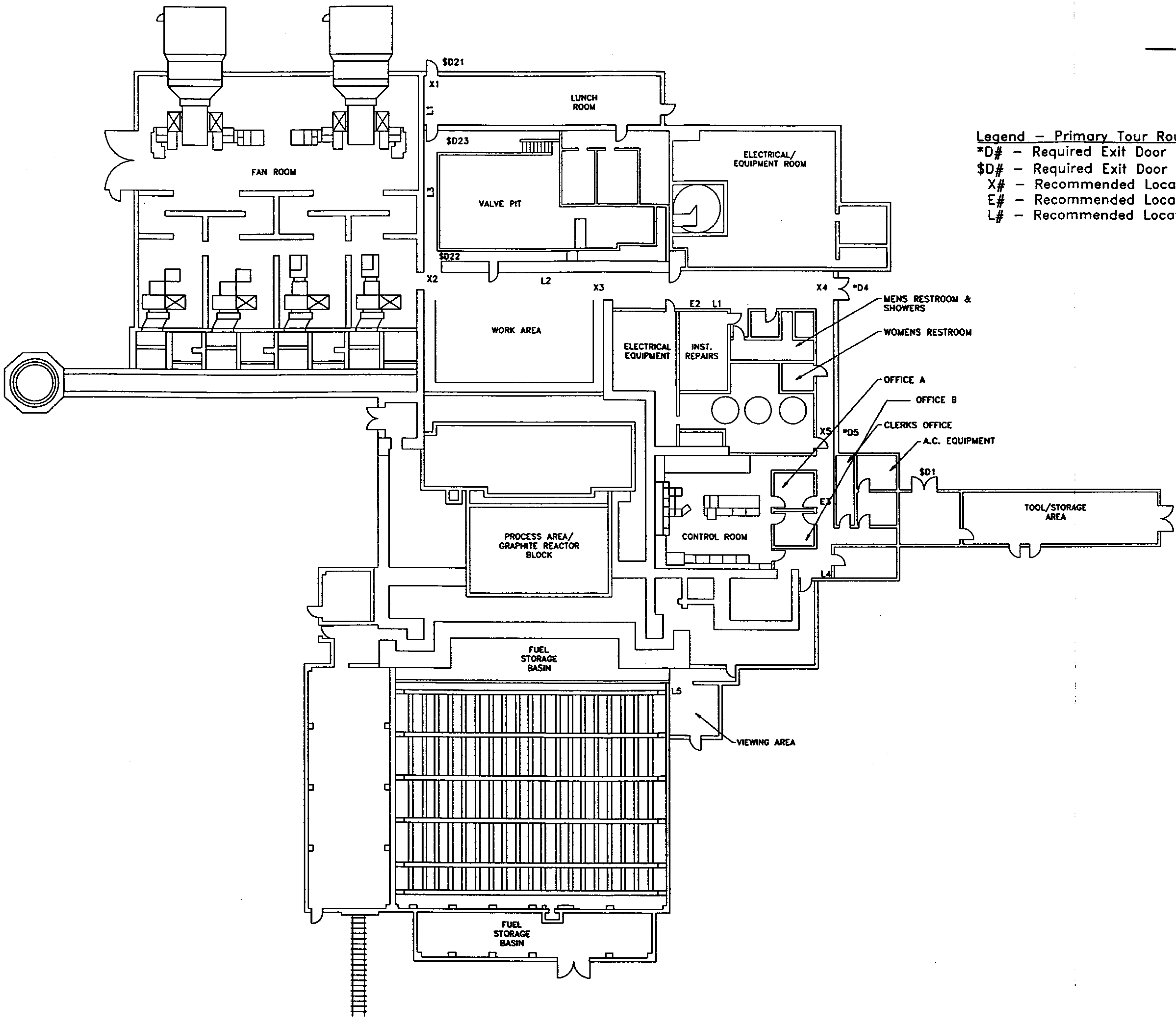
- Floor level – Door D4 does not meet the requirements of Section 5-2.1.3 of NFPA 101, which states that the floor surface on either side of a door shall not vary by greater than 0.5 in. This door consists of a set of sliding doors that have been modified by installing a single swinging personnel door in them. This single door is installed approximately 6 in. above the ground, requiring a "step up" to pass through the door. Therefore, the requirements of NFPA 101 are not met (see Section C.19.8).

- Grated walkways – Grated walkways are currently provided in the area above the valve pit. These walkways, which may create a tripping hazard, will be used to gain access to doors D21 and D23 (from the front-face work area) (see Section C.19.9.a).

- Panic hardware – Doors that are provided with a latch or lock are required to be provided with panic hardware in accordance with Section 8-2.2.2.3 of NFPA 101. Doors D5, D20, and D21 are provided with panic hardware, the condition of this equipment shall be inspected to ensure that these devices are operable and comply with NFPA 101, Section 5-2.1.7 (see Section C.19.9).

Figure C-2. 105-B Reactor Floor Plan.

Legend – Primary Tour Route
*D# – Required Exit Door – Currently Accessible
$D# – Required Exit Door – Make Accessible
X# – Recommended Location of Exit Signs
E# – Recommended Location of Extinguishers
L# – Recommended Location of Emergency Lights



- Door conditions – Doors throughout the facility shall be inspected to verify their condition. Damaged equipment observed during the walk-throughs include doorknobs that were difficult to turn or were slightly damaged, door closers that were damaged or broken, and glass panes that were missing (see Section C.19.9).

- Fire-resistant corridors – Section 8-3.6 of NFPA 101 requires corridors to be rated one-hour fire resistant, when used as an exit access, serving an area with an occupant load of 30 or greater. Currently these requirements are not met (see Section C.19.9).

C.9 CRITICAL PROCESS EQUIPMENT

There is no critical process equipment located in the B Reactor.

C.10 HIGH VALUE PROPERTY

High value property for purposes of this analysis is defined as property or equipment with replacement costs estimated in excess of $1 million as identified in the RL Property System. There is no specific equipment in the B Reactor identified as high value. The facility and contents have a "book" value of $64.6 million.

C.11 DAMAGE POTENTIAL

Estimates of damage potential are based on the worst-case fire events in the facility. Cost estimates include loss of contents, structural damage to the buildings, and contamination cleanup. On the basis of DOE Order 5480.7A, estimates of the MPFL assume that one automatic suppression system will malfunction. Manual firefighting efforts are also ignored for determination of the MPFL. Estimates of the MCFL are based on the assumption that the fire protection features, including automatic sprinkler systems, function as designed.

The B Reactor and contents have a "book" value of $64.6 million. In accordance with DOE Order 5480.7A, facilities having a MPFL in excess of $1 million require an automatic suppression system designed in accordance with the applicable NFPA standards. When the MPFL exceeds $50 million, a redundant fire protection system is required such that, despite the failure of the primary fire protection system, will limit the loss to $50 million. When the MPFL exceeds $150 million, a redundant fire protection system and a 3-hour fire resistance rated barrier are required to limit the MPFL to $150 million.

C.11.1 Maximum Possible Fire Loss

The maximum possible fire event in the B Reactor results from a fire in the fuel storage basin or control room. Fire spread throughout the B Reactor is unlikely due to the low combustible loading in other areas, lack of continuity of combustibles, and facility compartmentation. Damage results from structural damage, loss of contents, clean-up costs, clean-up costs of radiological contamination, and business interruption of the B Reactor as a tour facility. Although a detailed breakdown of facility structure and contents costs was unavailable it is reasonable to assume that a loss in excess of $1 million will result (see Section C.19.10).

C.11.2 Maximum Credible Fire Loss

The B Reactor is not protected by an automatic suppression system; therefore, the maximum credible fire loss is equal to the MPFL.

C.12 FIRE DEPARTMENT/BRIGADE RESPONSE

The HFD consists of four fire stations covering the 560-mi^2 area of the Hanford Site. These stations are strategically located across the Site to ensure minimum response time to all facilities. Front-line engines are aerial device/pumpers in all stations with regular pumpers as back-up/reserve. The HFD maintains a fleet of 39 vehicles with a diversified range of capabilities. Of these, 29 are fire/emergency response apparatus. Of the 29 emergency response apparatus, 24 are considered first-line equipment. The remainder are fully maintained reserves.

The 100 Area station is the closest to the B Reactor. The estimated response time for apparatus to arrive on the scene of an incident is expected to be 8 to 10 minutes after notification from the dispatch/communications center. This estimate assumes the firefighters are in the 100 Area fire station and normal road and traveling conditions.

The present operating procedure for a Hanford Site emergency response is to dispatch an ambulance and single aerial device/pumper from the closest station and a second aerial device/pumper from the next closest station. This provides a two-engine response with additional manpower/medical capabilities. The first apparatus due on the scene constitutes what is termed as "initial attack response capability."

The HFD has an established mutual/automatic aid agreement with the surrounding jurisdictions. The agreement enables the HFD to augment its own fire and emergency medical resources in the event of a major incident. This agreement is known as the "Tri-Cities Mutual Aid Agreement" and has been in existence since 1985. Participating agencies include the cities of Richland, Kennewick, and Pasco, and the fire protection districts of Benton County #1, Benton County #2, Benton County #3, Benton County #4, Benton County #5, Benton County #6, Franklin County #3, and Walla Walla County #5. Participation in the agreement is delivered using existing manpower and equipment.

C.13 RECOVERY POTENTIAL

A fire occurring in the B Reactor could result in extensive damage to the area of fire origin with smoke and heat damage to adjacent areas and possible spread of radiological contamination. Because the B Reactor is deactivated there are no concerns relative to re-establishing operations.

C.14 POTENTIAL FOR A TOXICOLOGICAL, BIOLOGICAL, AND/OR RADIOLOGICAL INCIDENT DUE TO A FIRE

This section addresses special fire hazards resulting from chemicals, radioactive materials, and toxic materials and the potential for their release to the site or the public. A release to the environment can create a health hazard and also result in contamination of both onsite and offsite areas.

The health hazards associated with toxicological, biological, and/or radiological materials are addressed in the Auditable Safety Analysis (BHI 1999). B Reactor contains fixed contamination in various areas. Contamination in the fuel storage basin is encapsulated with an asphaltic fixative. Asbestos is also contained in the building. There are no biological hazards in the building.

A fire involving the fuel storage basin could result in the release of the radiological material that is currently protected by the asphaltic fixative and can result in contamination spread within the facility and potentially to the outside. A full analysis of a fire occurring in the fuel storage basin is contained in the Auditable Safety Analysis (BHI 1999).

Contamination spread to other areas of the building could result in exposure to the occupants or fire response personnel (see Section C.19.2).

C.15 EMERGENCY PLANNING

The pre-fire plan for the B Reactor was reviewed for this FHA (HFD 1997). The pre-fire plan does not include information concerning the use of the B Reactor for limited tours (see Section C.19.11).

C.16 SECURITY AND SAFEGUARDS CONSIDERATIONS RELATED TO FIRE PROTECTION

Access to the facility is restricted to authorized or escorted personnel. There are no special security considerations identified that were judged to impact the FDH. There shall be minimal impact on fire department response time and access to the facility.

C.17 NATURAL HAZARDS IMPACT ON FIRE SAFETY

The impacts of floods, tornadoes, and earthquakes on the B Reactor have been previously analyzed and are presented below.

C.17.1 Floods

The Columbia River probable maximum flood (i.e., the flood discharge that may be expected from the most severe combination of meteorological and hydrologic conditions reasonably possible in the region) would produce a flow of 1,440,000 ft^3/s. This flood would not affect the central part of the Site (the plateau of the 200 East and West Areas), including the Plutonium Finishing Plant facilities. Likewise, waters of a 100-year flood (459,000 ft^3/s) would have no effect on the facility.

C.17.2 Tornadoes

The Pacific Northwest is one of the areas of the country with the lowest frequency of tornadoes. The entire state of Washington has an average tornado frequency of less than one per year. An analysis of the Hanford Site concludes that the probability of a tornado hitting any particular onsite facility is six chances in a million during any one year.

C.17.3 Earthquake

A 0.2-g (maximum) acceleration level at the ground surface in the site area is assigned as the design basis earthquake. The B Reactor is not designed to withstand a seismic event. Interior walls and exterior walls and equipment may fail during a seismic event.

C.18 EXPOSURE FIRE POTENTIAL

Minimum separation distances for adjacent structures are estimated based on procedures provided in NFPA 80A, *Recommended Practice for Fire Protection of Buildings from Exterior Fire Exposures*. There are no other facilities within close proximity to the B Reactor.

C.19 RECOMMENDATIONS

There are a number of life safety issues that must be upgraded so the B Reactor tour area complies with the *Life Safety Code* (NFPA 101).

C.19.1 Additional Fire Extinguishers

Additional fire extinguishers shall be installed in the B Reactor in accordance with NFPA 10. The distribution of extinguishers shall be in accordance with Table 3-2.1 (Class A hazards) and Table 3-3.1 (Class B hazards). The travel distance to an extinguisher shall not exceed 75 ft for Class A hazards and 30 ft in areas containing Class B hazards. Recommended locations for fire extinguishers are depicted in Figure C-1.

C.19.2 Fire Detection and Alarm System

The primary tour route and all areas used as a means of egress from the primary tour route shall be provided with a fire alarm and detection system. The system shall be initiated by manual-pull stations and fire detection devices installed throughout the areas. In areas where smoke detection devices are not effective, heat detection shall be used. In addition, detection devices shall be provided in the tour route in locations such that early detection of fires in remote areas will be provided (e.g., the fuel storage basin).

Activation of any initiating device shall notify occupants (audible and visible alarms) throughout the tour route and transmit a signal to the HFD.

C.19.3 Passive Protection

The wall separating the tool/storage room from the rest of the B Reactor shall be upgraded to at least a one-hour fire resistance rating in accordance with NFPA 101, Section 8-3.2.

C.19.4 Administrative Control of Occupant Load

The occupant load of the B Reactor shall be administratively controlled such that not more than 200 people are in the building at any time. This will address the need to provide an automatic sprinkler system throughout the ground-floor level of the building (required in an assembly occupancy with an occupant load greater than 300 people in accordance with NFPA 101, Section 8-3.5.1).

C.19.5 Additional Exits Required

Doors D4 and D5 on the primary tour route shall remain accessible while the building is occupied. Additional exits are required to meet the requirements for common path of travel and remoteness of exits for the front-face work area. Door D22 shall remain open and accessible to reduce the common path of travel in the front-face work area. An additional exit door (that exits to the lunch room) from the valve pit area is required to be made accessible. Door 21 (that exits to the outside) shall also be made accessible to provide occupants with a means of egress.

C.19.6 Additional Emergency Lights Required

Emergency lights are provided at various locations throughout the facility (see Table C-7). The following recommended locations are included in Figure C-1.

1. Additional emergency lights are required to be installed in the following areas:

    a. L-1 – Area adjacent to door D23.

    b. L-2 – Area adjacent to door D5. This door is currently used as a means of egress. Adequate emergency lighting shall be installed in area of this exit.

c. L-3 – Valve pit area. This area will be accessed as part of the means of egress to access door D21.

d. L-4 – Near control room. This emergency light is currently in place.

2. The operability of the emergency lights that are located behind the tour displays in the front-face work area, should be determined. If these lights are determined to be operational, they should be relocated to other areas in the work area; otherwise, these emergency lights should be removed.

C.19.7 Additional Exit Signs Required

The exit signs currently installed in the tour area shall be replaced by approved exit signs meeting the requirements of NFPA 101, Section 5-10. Exit signs shall be visible from every direction in the means of egress, are required to be illuminated, either externally or internally and shall meet the size requirements specified by the *Life Safety Code* (NFPA 101). The recommended locations are depicted in Figure C-1.

C.19.8 Floor Level

Door D4 shall be modified so that the floor surface on either side of the door does not vary by greater than 0.5 in., as required by Section 5-2.1.3 of NFPA 101. This door consists of a set of sliding doors that have been modified by installing a single swinging personnel door in them. This single door is installed approximately 6 in. above the ground, requiring a "step up" to pass through the door. Therefore, the requirements of NFPA 101 are not met.

This door shall be modified so the requirements of NFPA 101, Section 5-2.1.3, are met. In addition, if ramps are installed, they must meet the requirements of NFPA 101, Section 5-2.5 (minimum clear width = 44 in.; maximum slope = 1 in 12 for > 6 in. rise, 1 in 10 for > 3 in. and <= 6 in. rise, 1 in 8 for <= 3 in. rise; etc.).

C.19.9 Miscellaneous Improvements

1. Grated walkways – Grated walkways are currently provided in the area above the valve pit. These walkways, which may create a tripping hazard, will be used to gain access to doors D21 and D23 (from the front-face work area). The flooring in this area shall be replaced or covered so this tripping hazard is eliminated.

2. Panic hardware – Doors that are provided with a latch or lock are required to be provided with panic hardware in accordance with Section 8-2.2.2.3 of NFPA 101. Doors D5 and D21 are provided with panic hardware, and the condition of this equipment shall be inspected to ensure that these devices are operable and comply with NFPA 101, Section 5-2.1.7. Additionally any other doors provided with locks or latches shall be provided with panic hardware meeting the requirements of NFPA 101.

3. Door conditions – Doors throughout the facility shall be inspected to verify condition. Damaged equipment observed during walk-throughs include the following:

   a. Doorknobs – difficult to turn, slightly damaged, etc.
   b. Door closers – slightly damaged or broken.
   c. Glass panes – missing door D23.

The damaged equipment shall be fixed so that these doors are operational and meet the requirements of NFPA 101.

4. Fire-resistant corridors – Section 8-3.6 of NFPA 101 requires that the corridors provided as part of exit access, serving 30 or more occupants, to be one-hour fire resistant rated. This requirement is not met. It is recommended that an exemption request be prepared to eliminate this requirement.

C.19.10 Automatic Sprinkler Protection

Automatic sprinkler protection is required in all facilities with an MPFL in excess of $1 million. In addition, NFPA 101, Section 8-3.5.1, requires automatic sprinkler protection throughout the story containing an assembly occupancy when the occupant load is greater than 300 people.

It is recommended that the occupant load of the facility be administratively controlled to less than 200 people (see Section C.19.4). In addition, an exemption is required to address the monetary loss potential in excess of $1 million.

C.19.11 Pre-Fire Plan

The pre-fire plan is scheduled to be revised in 2002. However, the current plan does not reflect the use of the B Reactor as a limited tour facility. The pre-fire plan should be updated to reflect current facility use. In addition, procedures should be put in place to require HFD notification when a tour is taking place.

C.20 REFERENCES

BHI, 1999, *Surplus Reactor Auditable Safety Analysis*, BHI-01172, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE Order 5480.7A, *Fire Protection,* U.S. Department of Energy, Washington, D.C.

DOE Order 6430.1A, *General Design Criteria,* as amended, U.S. Department of Energy, Washington, D.C.

DOE, 1999, *Fire Protection Design Criteria,* DOE-STD-1066-99, U.S. Department of Energy, Washington, D.C.

FDH, 1999, *Guidance on Performance of Fire Hazard Analyses*, HNF-PRO-350, Rev. 3, Fluor Daniel Hanford, Inc., Richland, Washington.

Griffin, P. W., and J. J. Sharpe, 1999, *Hanford B Reactor Building Hazard Assessment Report*, BHI-01282, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Griffin, P. W., Battelle Pacific Northwest Laboratories, and Parsons Environmental Services, Inc., 1995, *105-B Reactor Facility Museum Phase I Feasibility Study Report*, BHI-00076, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

Hanford Fire Department Quick Access Pre-Fire Plan, 105-B Reactor, dated December 1997, Hanford Fire Department, Richland, Washington.

NFPA 10, *Standard for Portable Fire Extinguishers,* National Fire Protection Association, Quincy, Massachusetts.

NFPA 101, *Life Safety Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 220, *Standard on Types of Building Construction,* National Fire Protection Association, Quincy, Massachusetts.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, National Fire Protection Association, Quincy, Massachusetts.

RLID 5480.7, *Fire Protection*, as amended, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

UBC, 1997, *Uniform Building Code*, International Conference of Building Officials.

UFC, 1997, *Uniform Fire Code*, International Conference of Building Officials.

WHC, 1994, *Integration of Fire Hazards Analysis and Safety Analysis Report Requirements*, WHC-SD-GN-FHA-30001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX D

ENGINEERING DESIGN PACKAGE AND CONSTRUCTION COST ESTIMATE

DRAWING NO.	REV. NO.
0100B-DD-G0018	NONE

B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II

NOTES

BHI-01384
Rev. 0

G0018 TITLE SHEET

ARCHITECTURAL

A0002 FLOOR PLAN
A0003 ENLARGED REMODEL PLAN
A0004 ROOM SCHEDULE
A0005 DOOR SCHEDULE
A0006 PHOTO KEY PLAN
A0007 PHOTO PLAN
A0008 PHOTO PLAN
A0009 PHOTO PLAN

RESTROOM BUILDING

A0010 FLOOR PLAN & ELEVATIONS
A0011 SCHEDULES & DETAILS

STRUCTURAL

C0106 DETAILS

MECHANICAL

M0051 FLOOR PLAN
M0052 ENLARGED FLOOR PLAN AND SCHEDULES

RESTROOM BUILDING

M0053 FLOOR PLAN

ELECTRICAL

E0020 OVERALL ELECTRICAL PLAN
E0021 FLOOR PLANS
E0022 FIRE ALARM PLAN AND DIAGRAMS
E0023 ONE-LINE DIAGRAM AND PANELS

RESTROOM BUILDING

E0024 FLOOR PLANS

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/CHK'R	CHK'R CHK	CS	BHI PROJ CHK'R

SCALE:

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

BECHTEL HANFORD INC.
RICHLAND, WASHINGTON

MEIER Enterprises, Inc.

B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
TITLE SHEET

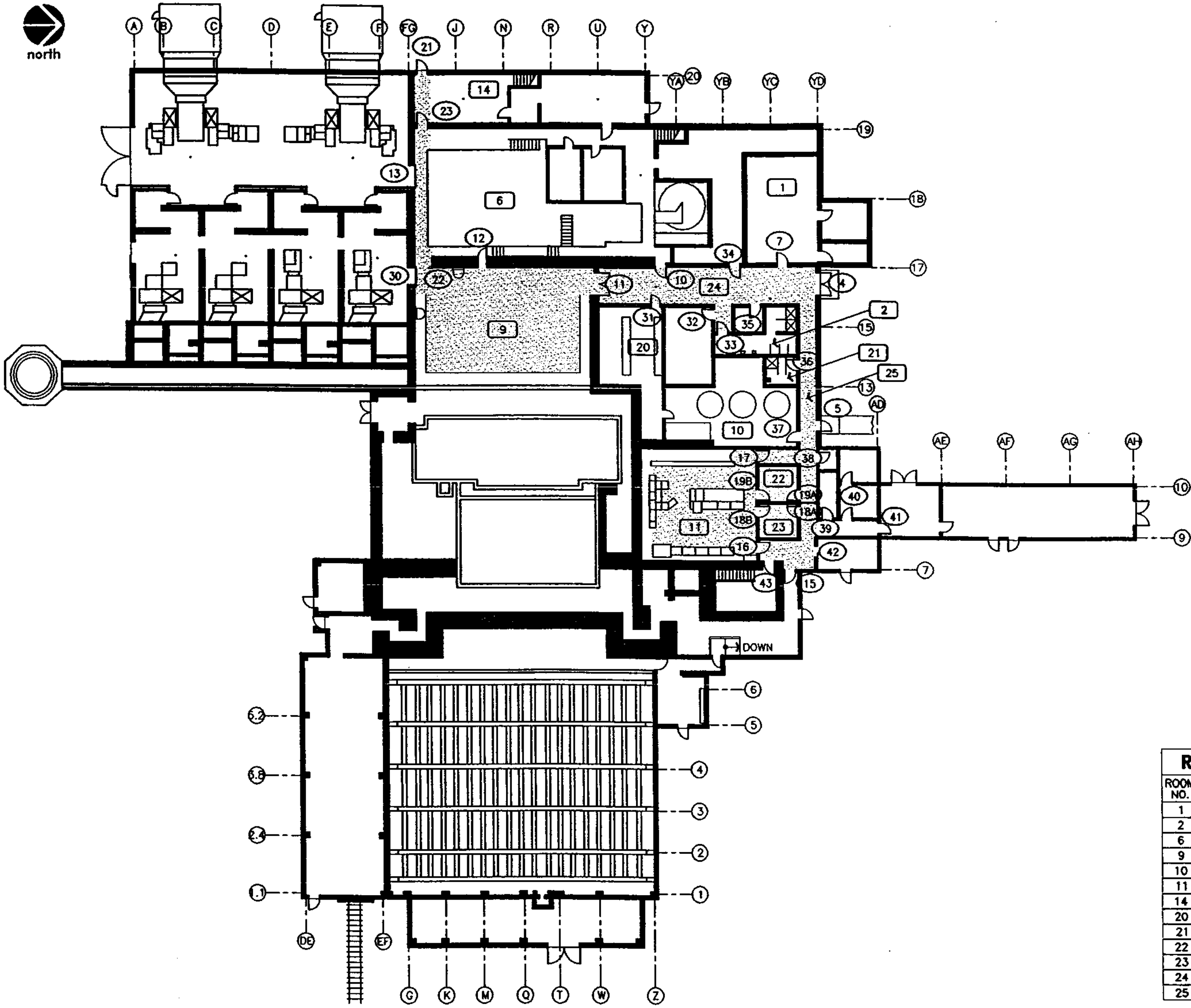
BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDG0018.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-G0018	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84542	105-B	0000

DRAWING NO.	REV. NO.
0100B-DD-A0002	NOTED



NOTES

BHI-01384
Rev. 0

LEGEND

C/C	CENTER TO CENTER
FF	FINISHED FLOOR
GWB	GYPSUM WALL BOARD
MAX	MAXIMUM
SQ FT	SQUARE FEET
1	ROOM NUMBER, SEE SCHEDULE ON A0004
1	DOOR NUMBER, SEE SCHEDULE ON A0005
19	GRID NUMBER
	TOUR AREA

ROOM DESCRIPTION

ROOM NO.	ROOM DESCRIPTION
1	ELECTRICAL/EQUIPMENT ROOM
2	MENS RESTROOM & SHOWER
6	VALVE PIT
9	WORK AREA
10	ACCUMULATOR ROOM
11	CONTROL ROOM
14	LUNCH ROOM
20	ELECTRICAL EQUIPMENT
21	WOMENS RESTROOM & SHOWER
22	OFFICE
23	OFFICE
24	CORRIDOR
25	CORRIDOR

FIRST FLOOR PLAN
SCALE: 1/16" = 1'-0"

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

BECHTEL HANFORD INC.
RICHLAND, WASHINGTON

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B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
ARCHITECTURAL FLOOR PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0002.DWG

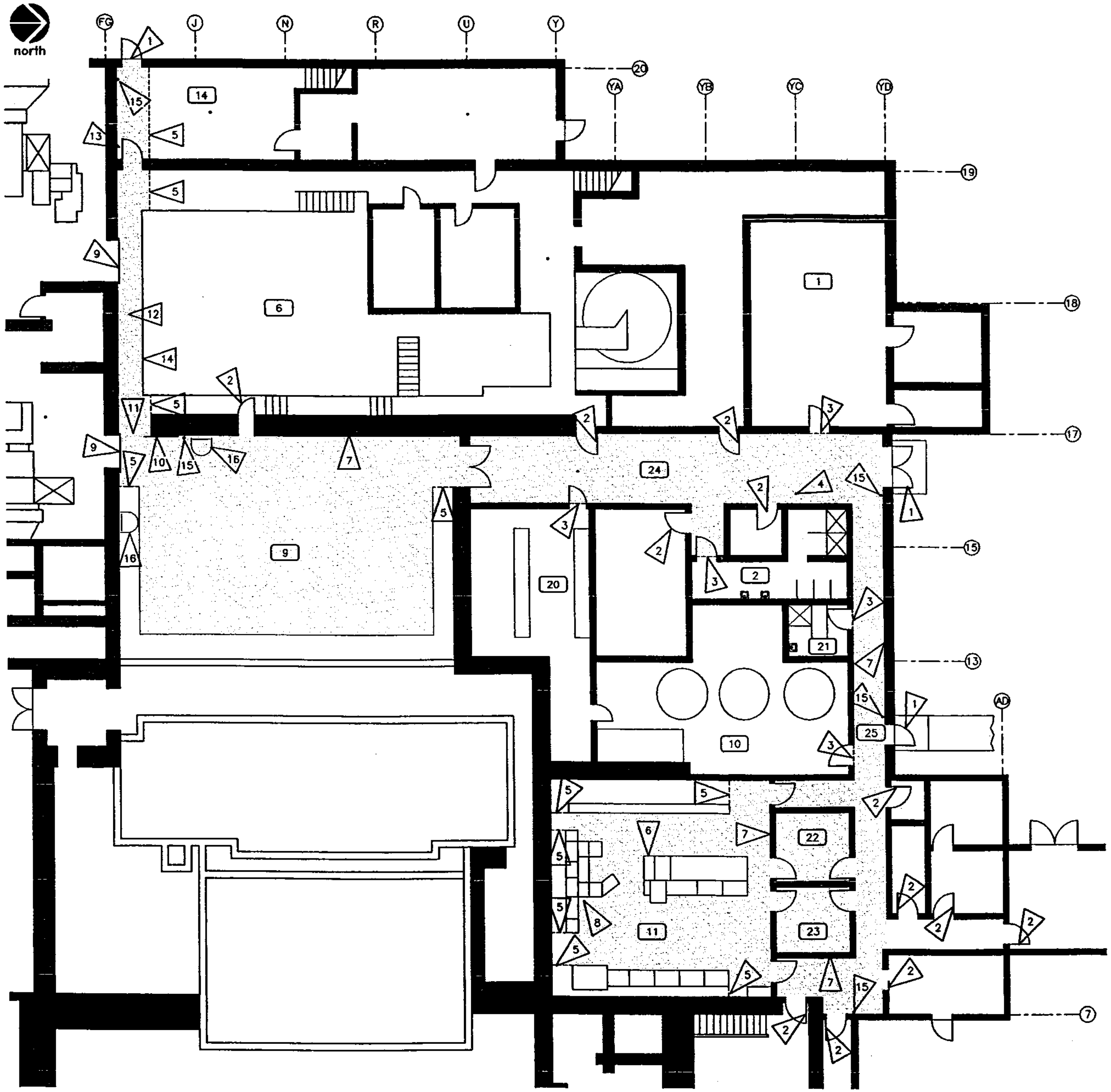
TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0002	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84543	105-B	0800

DRAWING NO.	REV. NO.
0100B-DD-A0003	NOTED

BHI-01384
Rev. 0



ENLARGED REMODEL PLAN

SCALE: 1/8" = 1'-0"

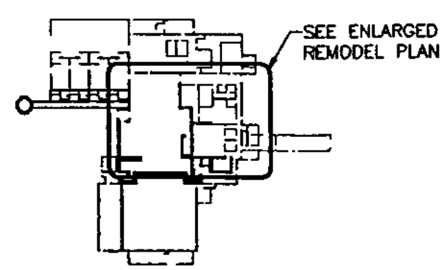
D-3

NOTES

1. FOR LEGEND AND ROOM DESCRIPTION, SEE A0002.

FLAG NOTES

1. REMOVE EXISTING DOOR AND FRAME. REPLACE WITH NEW HOLLOW METAL DOOR AND FRAME AND NEW LOCKSETS/LATCHSETS, CLOSURES, BUTTS, STOPS, AND EMERGENCY EXIT DEVICES. HOLLOW METAL DOOR SHALL MATCH ORIGINAL STYLE OF EXISTING DOOR. PROVIDE 4" THICK CONCRETE PADS AT EXTERIOR SIDE OF DOORS.
2. EXISTING DOORS TO BE CLOSED AND LOCKED SHUT.
3. PROVIDE 3/8"x36"WIDEx48"HIGH PLEXIGLAS SHIELD ACCESS DOOR OPENING. SHIELD SHALL BE MOUNTED WITH HINGED HARDWARE AND LOCKING FEATURES. SHIELD SHALL BE MOUNTED 6" ABOVE FLOOR LEVEL. TYP 5 LOCATIONS IN CORRIDOR.
4. EXISTING FLOOR DRAIN GRATE SHALL BE REMOVED AND DRAIN GROUTED SOLID.
5. PROVIDE 3/8"x48"HIGH PLEXIGLAS (VERIFY WIDTH) SHIELD ACCESS DOOR OPENING. SHIELD SHALL BE MOUNTED WITH HINGED HARDWARE AND LOCKING FEATURES. SHIELD SHALL BE MOUNTED 6" ABOVE FLOOR LEVEL. TYP 8 LOCATIONS IN CONTROL ROOM AND WORK ROOM.
6. REMOVE FLAKING PAINT AS REQUIRED TO RECEIVE NEW PAINT. TYP ALL EQUIPMENT IN CONTROL ROOM COLOR TO MATCH EXISTING.
7. REMOVE FLAKING PAINT AS REQUIRED TO RECEIVE NEW PAINT. TYP ALL WALLS WITHIN TOUR ROUTE, COLOR TO BE SELECTED BY OWNER.
8. REPAIR EXISTING VCT WHERE WORN AND/OR DAMAGED.
9. CLOSE EXISTING SLIDING DOOR AND LOCK SHUT.
10. OPEN EXISTING SLIDING DOOR AND LOCK IN OPEN POSITION.
11. MODIFY GRATE TO PROVIDE 1/2" MAX TRANSITION IN FLOOR SURFACES.
12. APPLY STEEL DIAMOND PLATE DECKING OVER EXISTING GRATING AT EXIST ROUTE ONLY.
13. EXISTING DOOR SHALL BE MODIFIED TO BE PERMANENTLY FIXED IN THE OPEN POSITION.
14. GUARDRAIL SHALL BE MODIFIED WITH INTERMEDIATE RAILS AT 4" C/C MAX SPACING.
15. NEW 5LB 2A 10BC MULTI PURPOSE FIRE EXTINGUISHERS WITH WALL BRACKETS, TYP.
16. EXISTING LADDER AND CAGE TO REMAIN.



KEY PLAN

NTS

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK'D	ORIG. CHK'D	CHK'R CHK'D	QS	DES. PROJ. CHK'D

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B REACTOR MUSEUM
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ARCHITECTURAL ENLARGED REMODEL PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0003.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0003	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84544	105-B	0800

DRAWING NO.	REV. NO.
0100B-DD-A0004	NONE

ROOM FINISH SCHEDULE

SHEET NUM.	ROOM NUM.	ROOM NAME	FLOOR		BASE	NORTH WALL			EAST WALL			SOUTH WALL			WEST WALL			CEILING				REMARKS
			MATERIAL	TYPE		MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	TYPE	COLOR	HEIGHT	
A0002	1	ELECTRICAL/EQUIPMENT ROOM	CONCRETE	VCT	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	2	MENS RESTROOM & SHOWER	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	6	VALVE PIT	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	9	WORK AREA	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	10	ACCUMULATOR ROOM	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	11	CONTROL ROOM	CONCRETE	VCT	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	14	LUNCH ROOM	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	20	ELECTRICAL EQUIPMENT	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	21	WOMENS RESTROOM & SHOWER	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	22	OFFICE	CONCRETE	VCT	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	23	OFFICE	CONCRETE	VCT	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	24	CORRIDOR	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–
A0002	25	CORRIDOR	CONCRETE	SEALER	RBR	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	ENAM	WHITE	–	–	–	–	–

ABBREVIATIONS:

ANDZ	ANODIZED
CMU	CONCRETE MASONRY UNIT
CONC	CONCRETE
ENAM	LATEX ENAMEL PAINT
EPOX	EPOXY PAINT
EXP'D	EXPOSED STRUCTURE
GWB	GYPSUM WALLBOARD
PLAM	PLASTIC LAMINATE
PLWD	PLYWOOD
PM	PRESSED METAL
PRE	PRE FINISHED
RBR	RUBBER
SATC	SUSPENDED ACOUSTIC TILE CEILING
SHT-V	SHEET VINYL
STL	STEEL
VCT	VINYL
VIN	COMPOSITION TILE VINYL
WD	WOOD

ROOM FINISH NOTES:

1. WALL AND CEILING COLOR DENOTED AS "WHITE" SHALL BE "OFF-WHITE". CONTRACTOR SHALL SUBMIT COLOR SAMPLES TO THE OWNER FOR APPROVAL.
2. ALL GWB SHALL BE 5/8" TYPE-X, GWB FINISH SHALL BE "LIGHT ORANGE PEEL".

NOTES

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Rev. 0

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ DSGN	DSGN CHK	QS	BH PROJ DSGN

SCALE:

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ARCHITECTURAL ROOM SCHEDULE

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0004.DWG

HANFORD	TASK	DRAWING NO.	REV. NO.
	100B	0100B-DD-A0004	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84545	105-B	0802

DRAWING NO.	REV. NO.
0100B-DD-A0005	NONE

DOOR SCHEDULE

SHEET NUM.	DOOR NUM.	NUM. OF DRS	OPENING SIZE W	H	T	DOOR TYPE	MAT'L	FINISH	LOUVER	GLASS	LABEL	FRAME TYPE	MAT'L	FINISH	REMARKS
A0002	4	2	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	HM	P-1	–
A0002	5	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	HM	P-1	–
A0002	7	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	10	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	11	2	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	12	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	13	1	–	–	–	B	–	–	–	–	–	–	–	–	–
A0002	15	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	16	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	17	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	18A	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	18B	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	19A	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	19B	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	21	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	HM	P-1	–
A0002	22	1	–	–	–	B	–	–	–	–	–	–	–	–	–
A0002	23	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	30	1	–	–	–	B	–	–	–	–	–	–	–	–	–
A0002	31	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	32	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	33	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	34	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	35	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	36	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	37	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	38	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	39	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	40	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	41	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR
A0002	42	1	–	–	–	B	–	–	–	–	–	–	–	–	–
A0002	43	1	3'-0	7'-0	1-3/4"	A	WD	–	–	–	–	1	WD	P-1	EXISTING DOOR

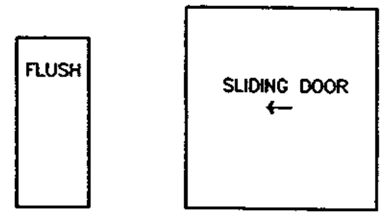
ABBREVIATIONS:

ALUM	ALUMINUM
ANDZ	ANODIZED
ENAM	ENAMEL PAINT
HC	HOLLOW CORE (WOOD)
HM	HOLLOW METAL
PLAM	PLASTIC LAMINATE
PM	PRESSED METAL
PRE	PREFINISHED
SC	SOLID CORE (WOOD)
STL	STEEL
WD	WOOD

DOOR SCHEDULE NOTES:

1. DOOR AND FRAME FINISH COLORS SHALL BE DETERMINED BY THE OWNER. CONTRACTOR SHALL SUBMIT SAMPLES FOR APPROVAL.

DOOR TYPES:



A B

NOTES

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REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENG'R	ENG'R CHK	CS	BH PROJ ENG'R

SCALE:

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ARCHITECTURAL DOOR SCHEDULE

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0005.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0005	0

HANFORD

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84546	105-B	0802

DRAWING NO.	REV. NO.
0100B-DD-A0006	NOTED

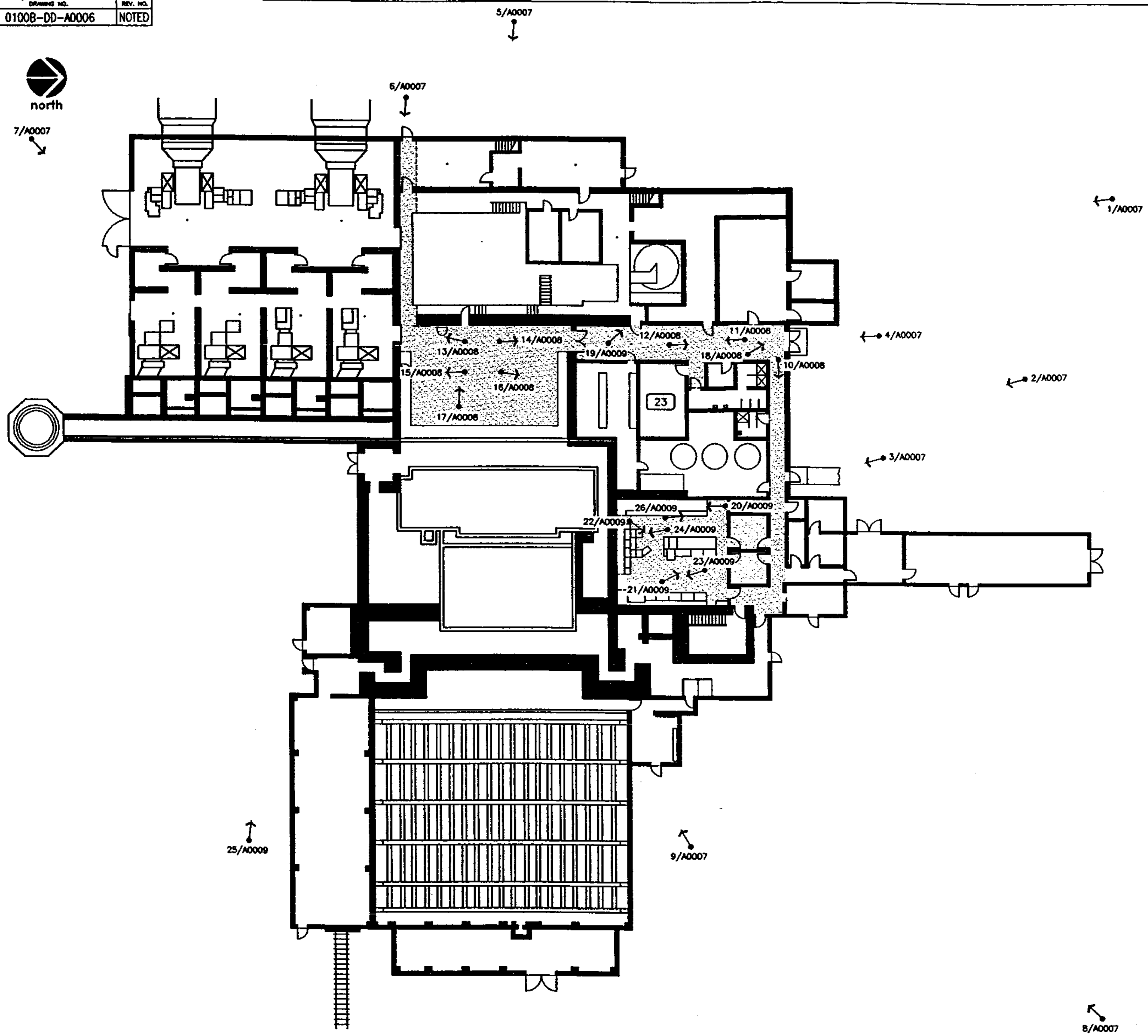

PHOTO KEY PLAN

SCALE: 1/16" = 1'-0"

D-6

NOTES

BHI-01384
Rev. 0

LEGEND

5/A0007 PHOTO NUMBER / SHEET NUMBER

CAMERA LOCATION AND DIRECTION TAKEN

REV.	DATE	DESCRIPTION	DRAWN BY	DWGT CHK	CHKD/ENG'R	ENG'R CHK	QS	BHI PROJ ENG'R

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BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0006.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0006	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84547	105-B	0802

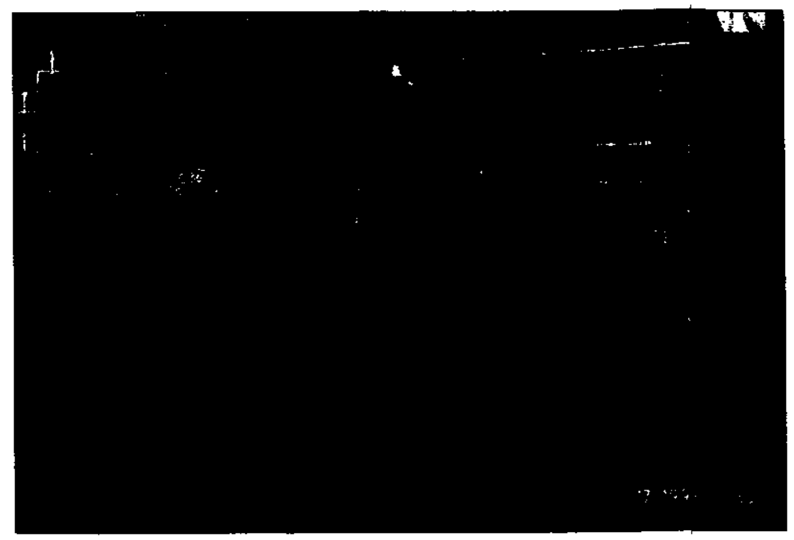
DRAWING NO.	REV. NO.
0100B-DD-A0007	NONE

NOTES

BHI-01384
Rev. 0

PHOTO 1
P0003535

PHOTO 2
P0003566



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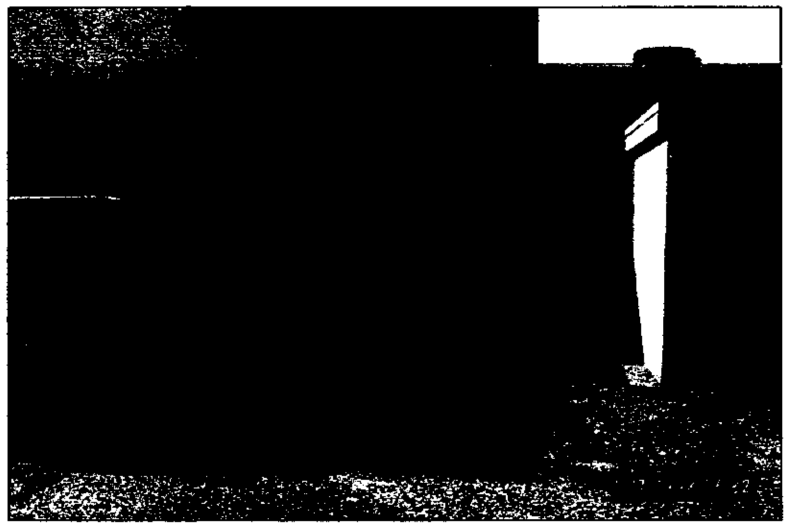
P0003752



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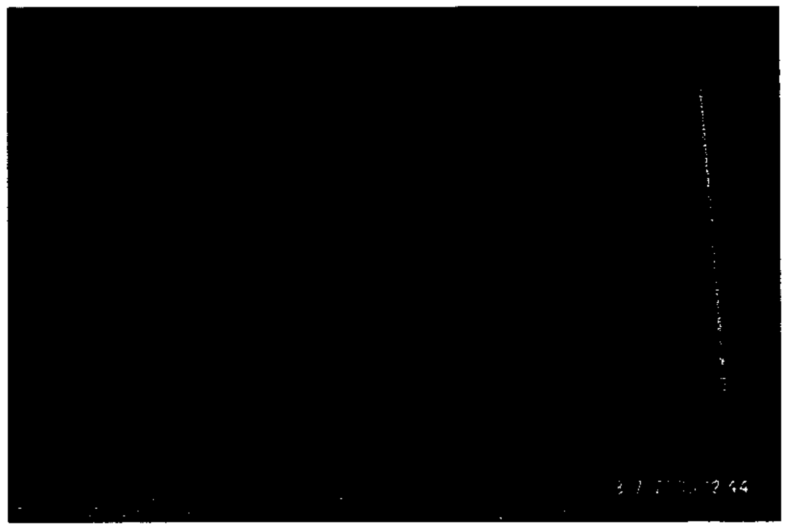

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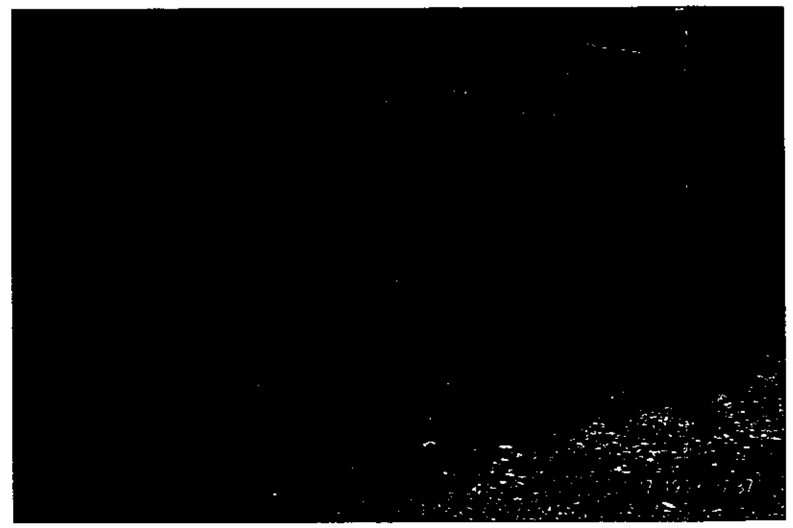

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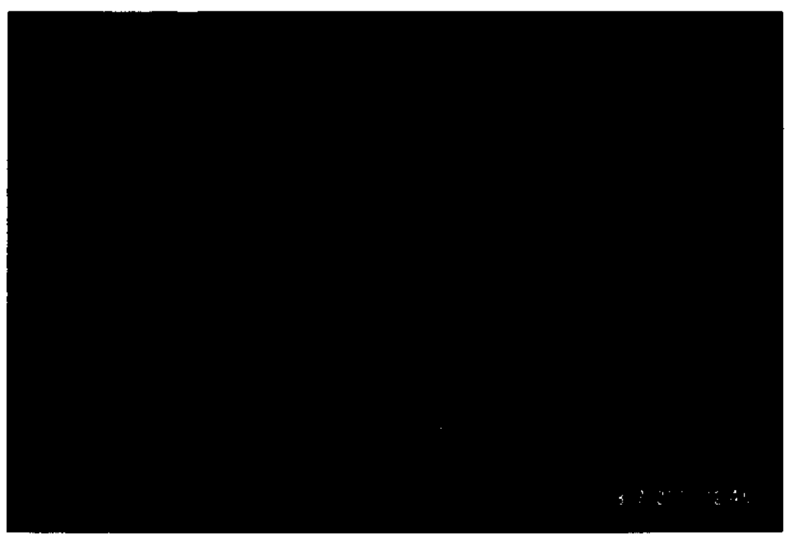

PHOTO 7
P0003568

PHOTO 8
P0003554

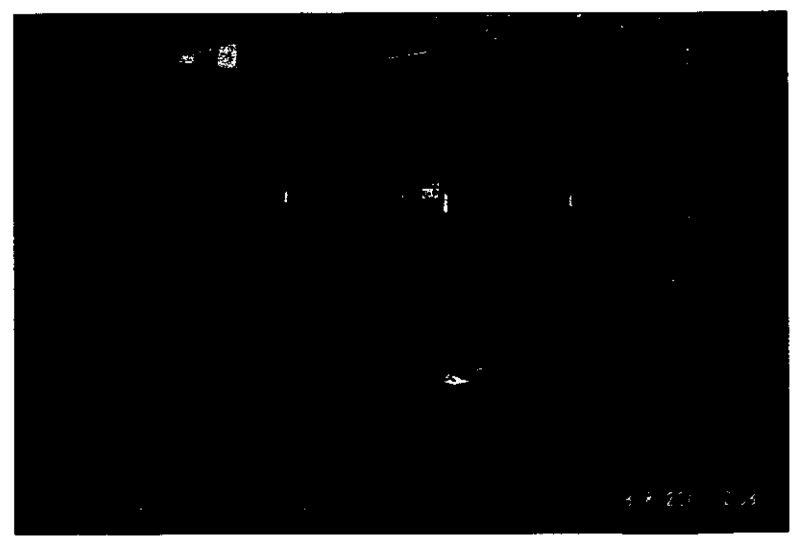

PHOTO 9
P0003630

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FEASIBILITY ASSESSMENT PHASE II
PHOTO PLAN

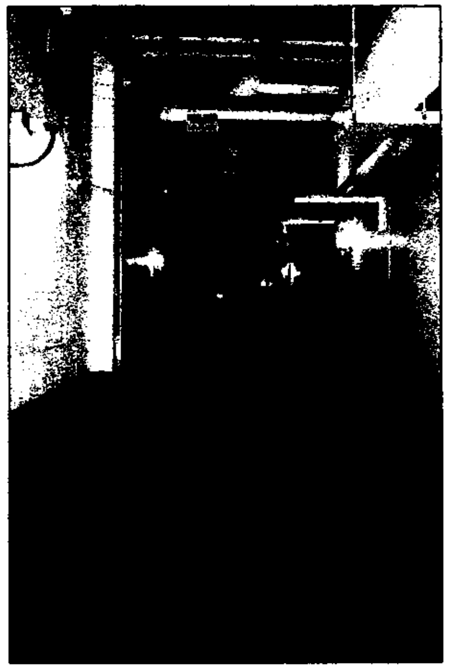
BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0007.DWG

	TASK	DRAWING NO.	REV. NO.
HANFORD	100B	0100B-DD-A0007	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84548	105-B	0802

DRAWING NO.	REV. NO.
0100B-DD-A0008	NOTED



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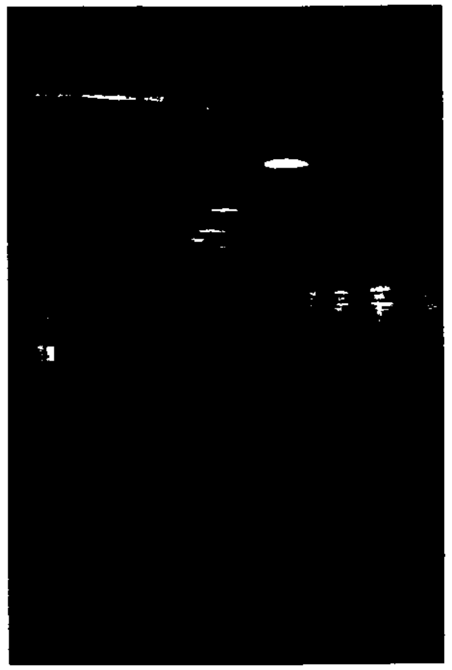

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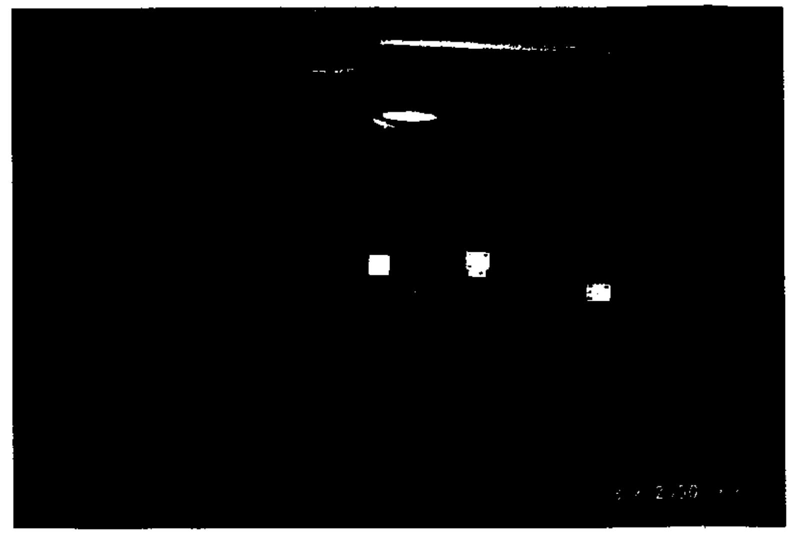

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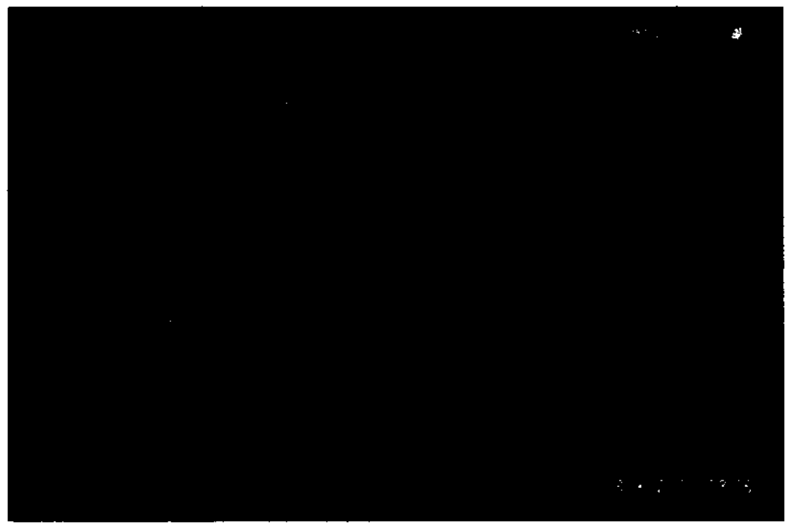

PHOTO 13
P0003576

PHOTO 14
P0003577

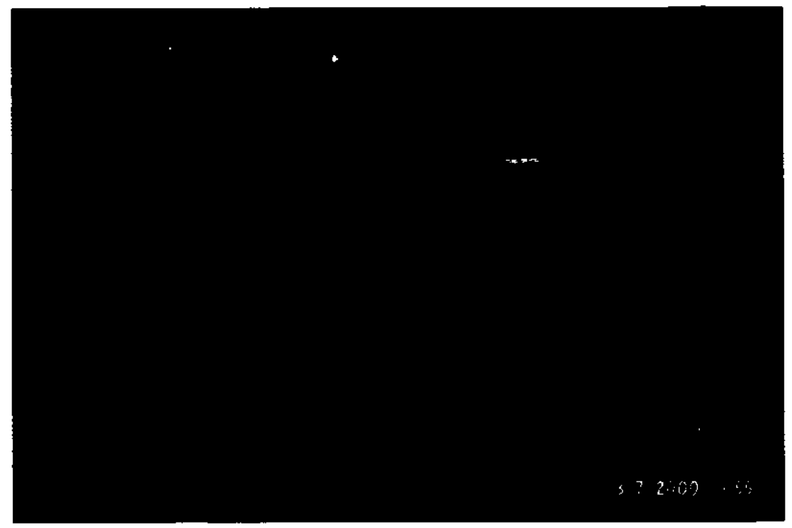

PHOTO 15
P0003560

PHOTO 16
P0003579

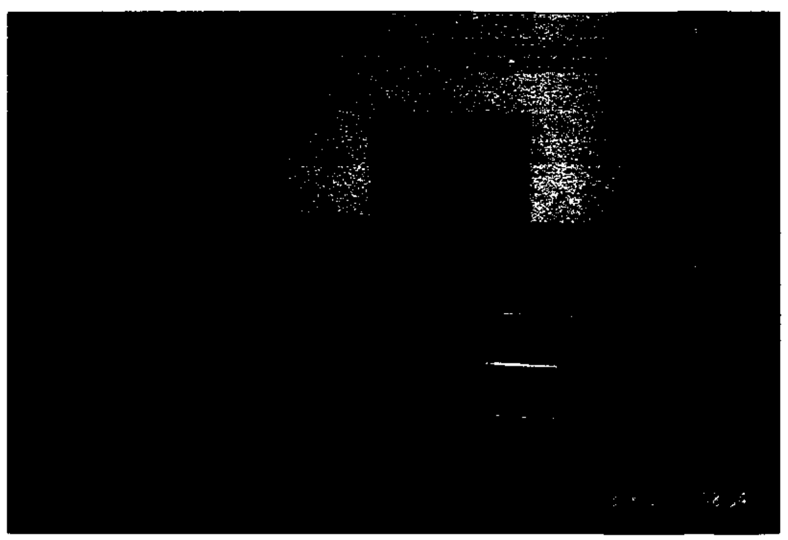

PHOTO 17
P0003575

PHOTO 18
P0003573

NOTES

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Rev. 0

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENG'R	ENG'R CHK	CS	BHI PROJ ENG'R

SCALE:

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

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RICHLAND, WASHINGTON

MEIER Enterprises, Inc.

B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
PHOTO PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0008.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0008	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84549	105-B	0802

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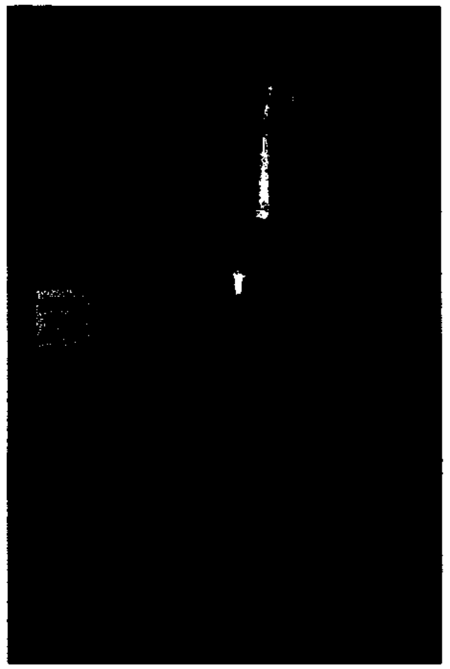
0100B-DD-A0009	NONE



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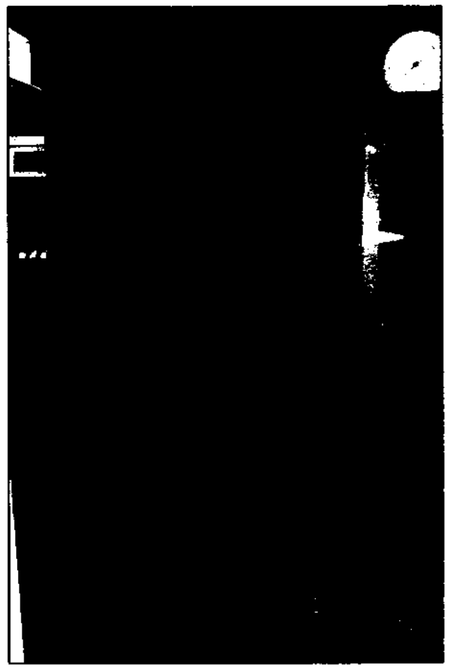

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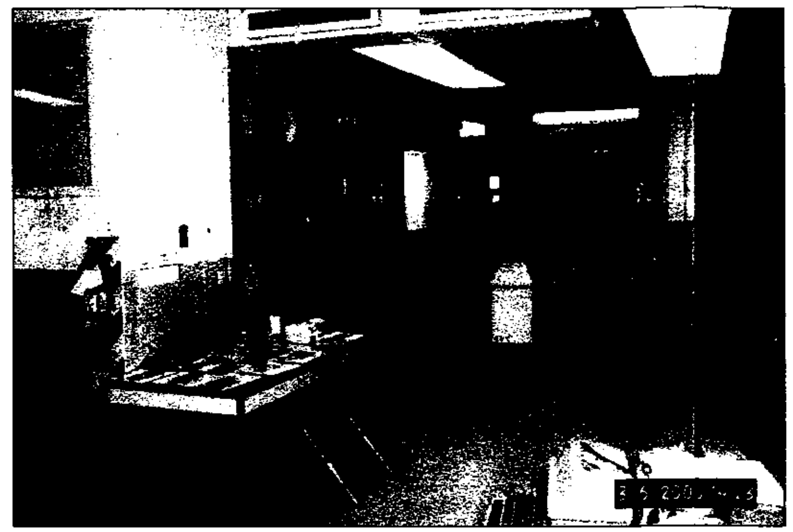

PHOTO 21
P0003545

PHOTO 22
P0003544

PHOTO 23
P0003546

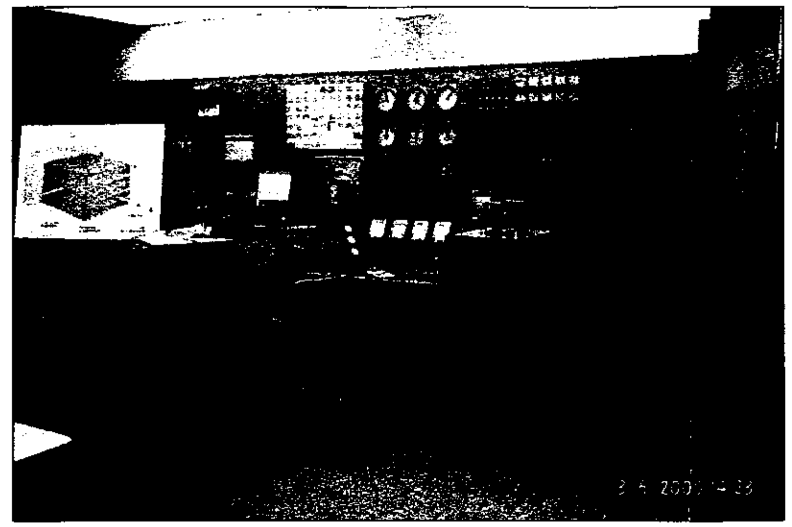

PHOTO 24
P0003543

PHOTO 25
P0003755

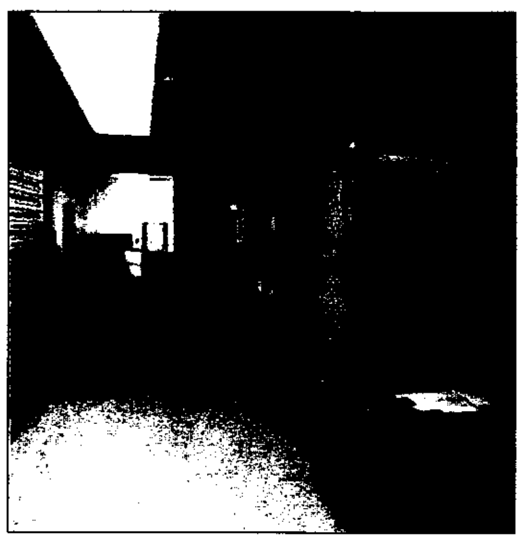

PHOTO 26
BHI01282-01

NOTES

BHI-01384
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SCALE:

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FEASIBILITY ASSESSMENT PHASE II
PHOTO PLAN

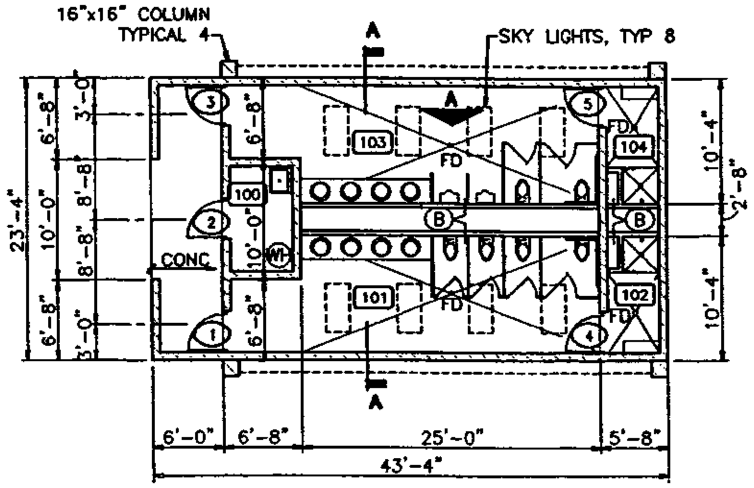
BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0009.DWG

	TASK	DRAWING NO.	REV. NO.
HANFORD	100B	0100B-DD-A0009	0

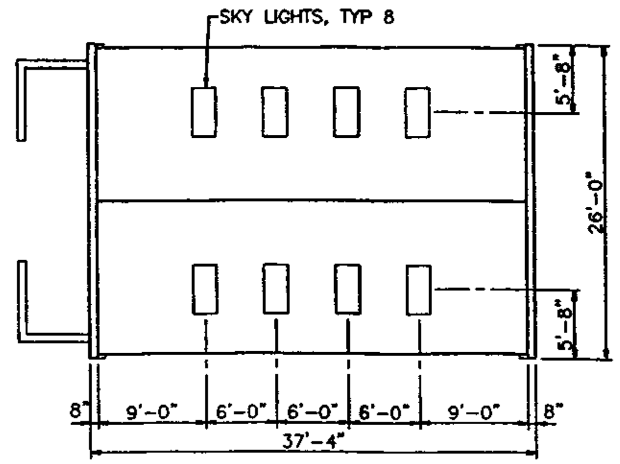
RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84550	105-B	0802

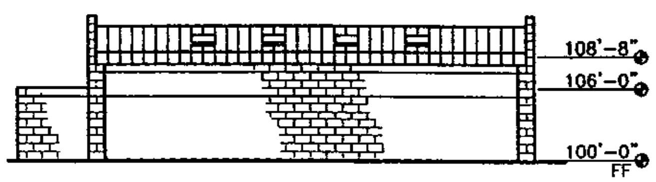
DRAWING NO.	REV. NO.
0100B-DD-A0010	NOTED



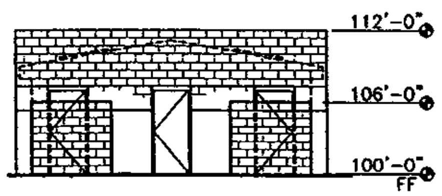
FLOOR PLAN
SCALE: 1/8" = 1'-0"



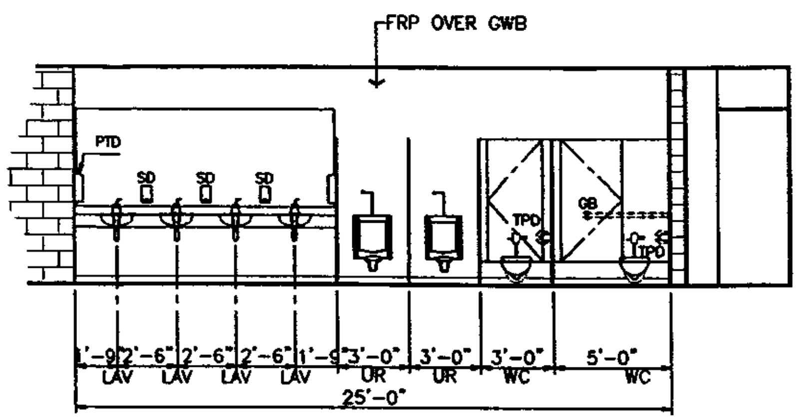
ROOF PLAN
SCALE: 1/8" = 1'-0"



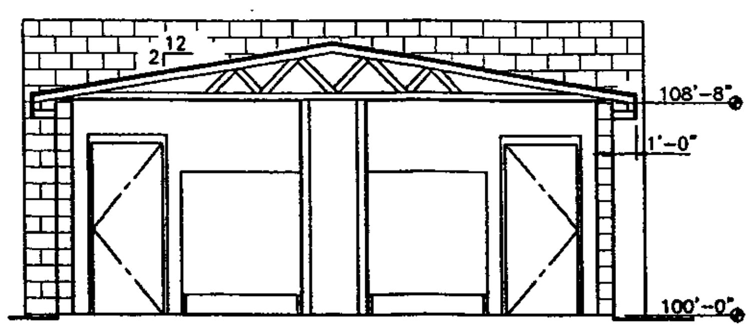
NORTH ELEVATION
SCALE: 1/8" = 1'-0"



SOUTH ELEVATION
SCALE: 1/8" = 1'-0"



ELEVATION A
SCALE: 1/4" = 1'-0"



A SECTION
1/4" = 1'-0"

D-10

ROOM NO.	ROOM DESCRIPTION
100	JANITOR/MECHANICAL
101	WOMENS RESTROOM
102	WOMENS SHOWER
103	MENS RESTROOM
104	MENS SHOWER

NOTES

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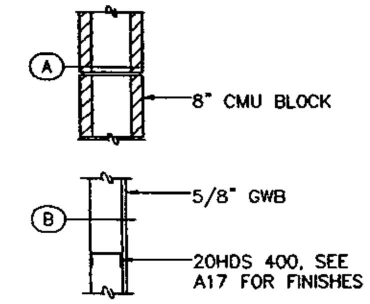
LEGEND

CONC	CONCRETE
FD	FLOOR DRAIN
FF	FINISHED FLOOR
FRP	FIBERGLASS REINFORCED PLASTIC
FRIG	REFRIGERATOR
GB	GRAB BAR
GWB	GYPSUM WALL BOARD
LAV	LAVATORY
PTD	PAPER TOWER DISPENSER
SD	SOAP DISPENSER
SQ FT	SQUARE FEET
UR	URINAL
WH	WATER HEATER
100	ROOM NUMBER, SEE SCHEDULE ON A0011
1	DOOR NUMBER, SEE SCHEDULE ON A0011
	CMU BLOCK WALL
A	WALL TYPE
	CURTAIN

WALL TYPES

WALLS NOT NOTED ARE WALL TYPE A



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B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
ARCHITECTURAL RESTROOM FLOOR PLAN, ELEVATIONS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0010.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0010	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84551	105-B	0802

DRAWING NO.	REV. NO.
0100B-DD-A0011	NONE

ROOM FINISH SCHEDULE

SHEET NUM.	ROOM NUM.	ROOM NAME	FLOOR		BASE	NORTH WALL			EAST WALL			SOUTH WALL			WEST WALL			CEILING				REMARKS
			MATERIAL	TYPE		MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	FINISH	COLOR	MAT'L	TYPE	COLOR	HEIGHT	
A0010	100	JANITOR/MECH	CONCRETE	SEALER	RBR	CMU	SLR	–	CMU	SLR	–	CMU	SLR	–	CMU	SLR	–	GWB	–	WHITE	9'-8"	–
A0010	101	WOMENS RESTROOM	CONCRETE	SEALER	RBR	GWB	ENAM	WHITE	CMU	SLR	–	CMU	SLR	–	CMU	SLR	–	GWB	–	WHITE	9'-8"	–
A0010	102	WOMENS SHOWER	CONCRETE	SEALER	RBR	GWB	ENAM	WHITE	CMU	SLR	–	CMU	SLR	–	CMU	SLR	–	GWB	–	WHITE	9'-8"	–
A0010	103	MENS RESTROOM	CONCRETE	SEALER	RBR	CMU	SLR	–	CMU	SLR	–	GWB	ENAM	WHITE	CMU	SLR	–	GWB	–	WHITE	9'-8"	–
A0010	104	MENS SHOWER	CONCRETE	SEALER	RBR	CMU	SLR	–	CMU	SLR	–	GWB	ENAM	WHITE	CMU	SLR	–	GWB	–	WHITE	9'-8"	–

ABBREVIATIONS:

ANDZ ANODIZED
CMU CONCRETE MASONRY UNIT
CONC CONCRETE
ENAM LATEX ENAMEL PAINT
EPOX EPOXY PAINT
EXP'D EXPOSED STRUCTURE
GWB GYPSUM WALLBOARD
PLAM PLASTIC LAMINATE
PLWD PLYWOOD
PM PRESSED METAL
PRE PRE FINISHED
RBR RUBBER
SATC SUSPENDED ACOUSTIC TILE CEILING
SHT-V SHEET VINYL
STL STEEL
VCT VINYL
VIN COMPOSITION TILE VINYL
WD WOOD

ROOM FINISH NOTES:

1. WALL AND CEILING COLOR DENOTED AS "WHITE" SHALL BE "OFF-WHITE". CONTRACTOR SHALL SUBMIT COLOR SAMPLES TO THE OWNER FOR APPROVAL.
2. ALL GWB SHALL BE 5/8" TYPE-X. GWB FINISH SHALL BE "LIGHT ORANGE PEEL".

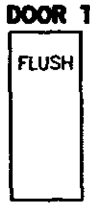
DOOR SCHEDULE

SHEET NUM.	DOOR NUM.	NUM. OF DRS	OPENING SIZE			DOOR					LABEL	FRAME			REMARKS
			W	H	T	TYPE	MAT'L	FINISH	LOUVER	GLASS		TYPE	MAT'L	FINISH	
A0010	1	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	PM	P-1	–
A0010	2	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	PM	P-1	–
A0010	3	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	PM	P-1	–
A0010	4	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	PM	P-1	–
A0010	5	1	3'-0	7'-0	1-3/4"	A	HM	–	–	–	–	1	PM	P-1	–

ABBREVIATIONS:

ALUM ALUMINUM
ANDZ ANODIZED
ENAM ENAMEL PAINT
HC HOLLOW CORE (WOOD)
HM HOLLOW METAL
PLAM PLASTIC LAMINATE
PM PRESSED METAL
PRE PREFINISHED
SC SOLID CORE (WOOD)
STL STEEL
WD WOOD

DOOR TYPES:



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DOOR SCHEDULE NOTES:

1. DOOR AND FRAME FINISH COLORS SHALL BE DETERMINED BY THE OWNER. CONTRACTOR SHALL SUBMIT SAMPLES FOR APPROVAL.

NOTES

1. FOR NOTES AND LEGEND, SEE A0010.

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FEASIBILITY ASSESSMENT PHASE II
ARCHITECTURAL RESTROOM SCHEDULES & DETAILS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDA0011.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-A0011	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84552	105-B	0802

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DRAWING NO.	REV. NO.
0100B-DD-C0106	NOTED

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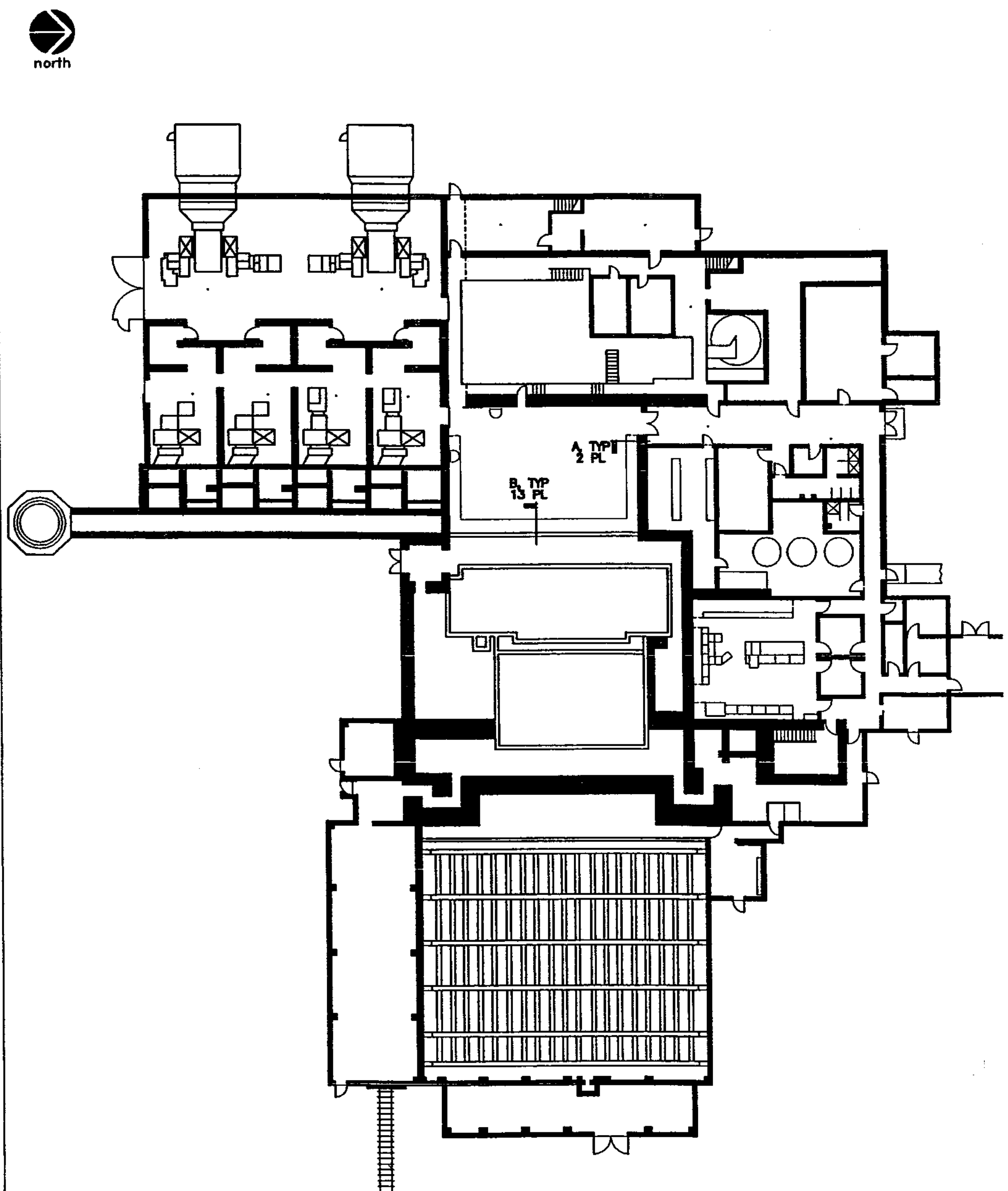
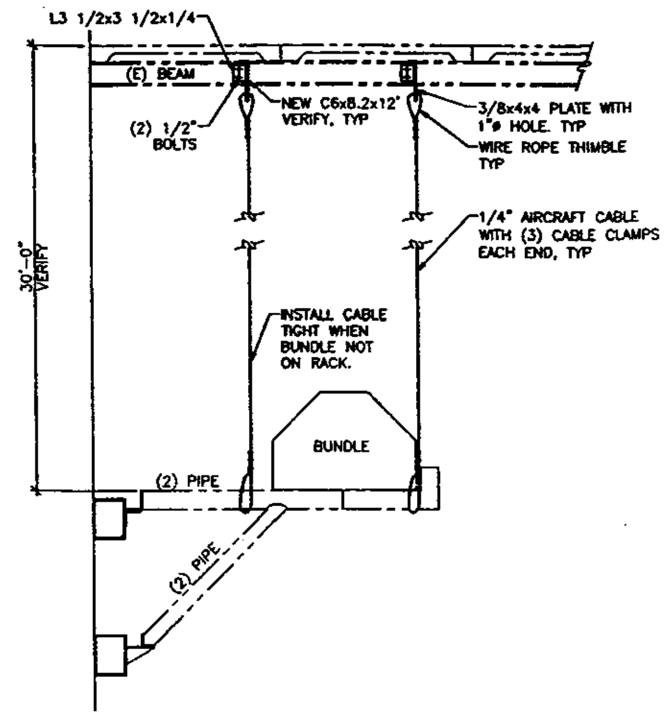
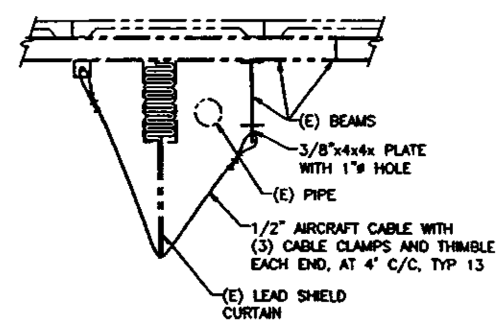


D-12 PARTIAL PLAN
SCALE: 1/16" = 1'-0"



A SECTION
1/2" = 1'-0"



B SECTION
1/2" = 1'-0"

NOTES

1. THE UNIFORM BUILDING CODE (UBC), LOCAL RULES AND STANDARDS OF GOVERNING AGENCIES HAVING JURISDICTION.
2. CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF SITE CONDITIONS, INSTALLATION STANDARDS AND CONSTRUCTION CONDITIONS. FIELD VERIFY ALL DIMENSIONS. DISCREPANCIES BETWEEN SITE CONDITIONS AND THE CONSTRUCTION DRAWINGS SHALL BE CALLED TO THE ATTENTION OF THE ENGINEER. WORK DONE WITHOUT THE ENGINEERS APPROVAL IS THE RESPONSIBILITY OF THE CONTRACTOR.
3. CONTRACTOR SHALL FIELD VERIFY WEIGHT OF LEAD SHIELD CURTAIN.
4. CONTRACTOR SHALL FIELD VERIFY WEIGHT OF BUNDLE RACK AND THAT EACH SUPPORT RACK SUPPORTS APPROXIMATELY 1/2 OF THE BUNDLE RACK.
5. ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM A36.
6. AIRCRAFT CABLE SHALL BE MCMASTER CARR 3332T56 GALVANIZED STEEL 7X19 EXTRA FLEX AIRCRAFT CABLE WITH MINIMUM BREAK STRENGTH OF 7,000 POUNDS OR APPROVED EQUAL.
7. CABLE CLAMPS SHALL BE MCMASTER CARR 3465T13 U-BOLT WIRE ROPE CLAMPS. INSTALL U-SECTION OF CLAMP ON DEAD SIDE (OR SHORT END) OF ROPE AND SADDLE ON LIVE SIDE (OR LONG END) OF ROPE. MINIMUM 15 FOOT-POUNDS TORGUE ON ALL NUTS. SPACE CLAMPS 4 FOOT C/C WITH 3 INCHES MINIMUM EXTENTSION BEYOND END CLAMP.
8. WIRE ROPE THIMBLE SHALL BE MCMASTER CARR 3495T14 HEAVY PATTERN HOT DIPPED GALVANIZED STEEL THIMBLE.
9. ALL BOLTS SHALL CONFORM TO ASTM A307.
10. BOLT HOLES SHALL BE BOLT DIAMETER + 1/16". BOLT END AND EDGE DISTANCES SHALL BE 1 1/2 INCHES UNLESS OTHERWISE NOTED.
11. PAINT ALL NEW FERROUS METALS.
12. DESIGN LOADS:

    LEAD SHIELD CURTAIN: 7.5 POUNDS PER SQUARE FOOT MAXIMUM

    BUNDLE RACK: 4,000 POUNDS MAXIMUM TOTAL (SHARED EQUALLY BY TWO SUPPORTS)

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FEASIBILITY ASSESSMENT PHASE II
STRUCTURAL DETAILS

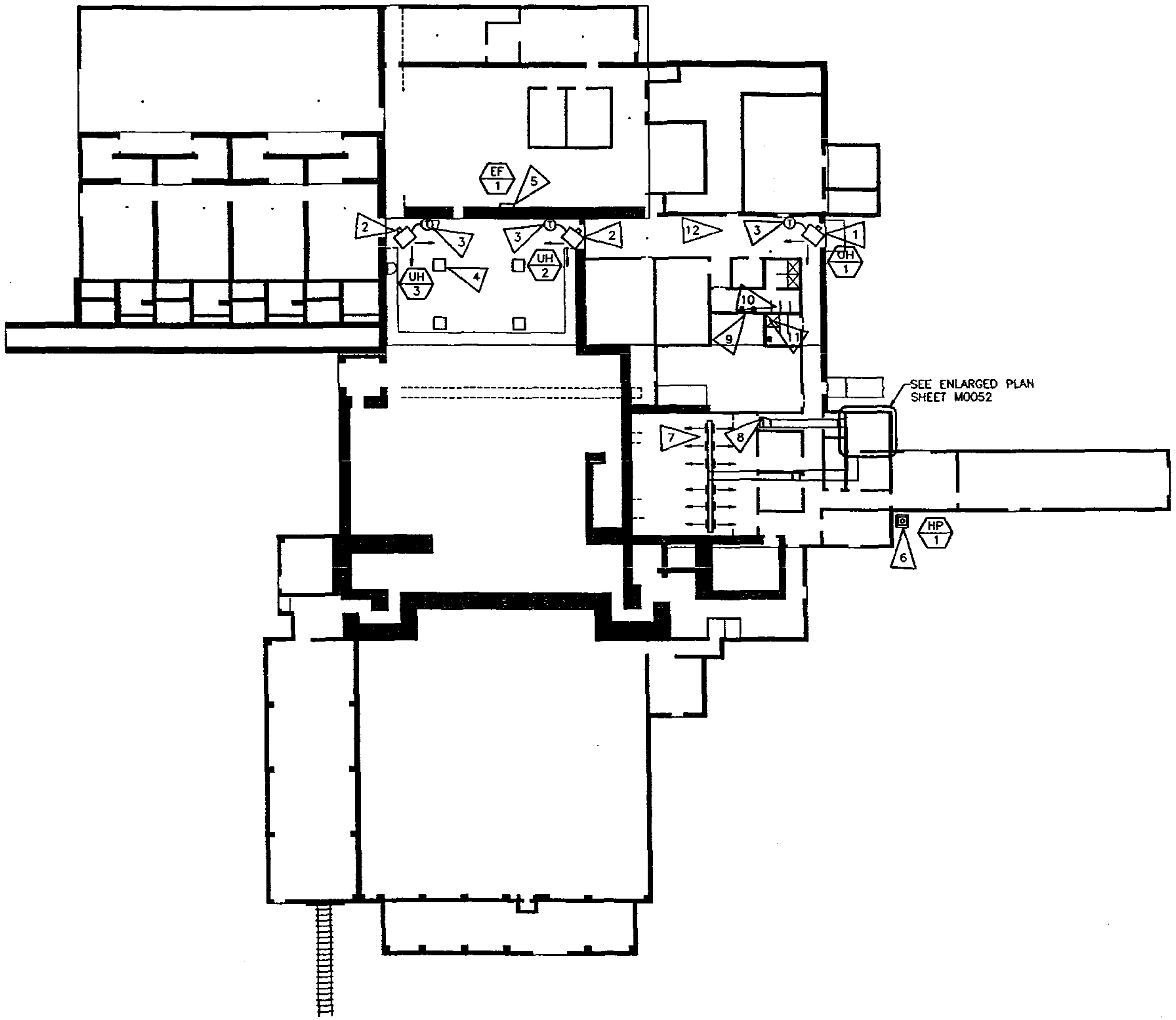
BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDC0106.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-C0106	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84561	105-B	1000

DRAWING NO.	REV. NO.
0100B-DD-M0051	NOTED



MECHANICAL FLOOR PLAN

SCALE: 1/16" = 1'-0"

LEGEND

EF	EXHAUST FAN
FC	FAN-COIL UNIT
HP	HEAT PUMP
UH	UNIT HEATER

BHI-01384
Rev. 0

NOTES

1. INSTALL EQUIPMENT IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS. PROVIDE INCIDENTAL ITEMS AS NEEDED FOR A COMPLETE INSTALLATION.
2. RIGID DUCTWORK SHALL BE GALVANIZED STEEL SHEET. FABRICATE, INSTALL AND SUPPORT IN ACCORDANCE WITH SMACNA HVAC DUCT CONSTRUCTION STANDARDS, 1/2" WG PRESSURE CLASS.
3. DUCTWORK INSULATION SHALL BE FLEXIBLE GLASS FIBER WRAP INSULATION WITH FSK FACING. INSULATE NEW DUCTWORK IN MECHANICAL ROOM.
4. REFRIGERANT PIPING SHALL BE TYPE ACR COPPER TUBE WITH WROUGHT COPPER FITTINGS AND BRAZED JOINTS. FABRICATE, INSTALL, SUPPORT AND TEST IN ACCORDANCE WITH ASME B1.5, "REFRIGERANT PIPING". EVACUATE SYSTEM AND FILL WITH OPERATING CHARGE OF REFRIGERANT.

FLAG NOTES

1. MOUNT UNIT HEATER ON WALL BRACKET AT ±12' A.F.F.
2. MOUNT UNIT HEATER ON WALL BRACKET AT ±9' A.F.F.
3. MOUNT THERMOSTAT ON WALL AT ±48" A.F.F. CONNECT FOR CONTROL OF UNIT HEATER INDICATED. PROVIDE LOCKABLE COVER.
4. BLANK OFF AND SEAL DUCTWORK PENETRATION THROUGH ROOF. (TYP 4 PLACES)
5. INSTALL EXHAUST FAN IN SLEEVE THROUGH WALL ±20' A.F.F.
6. SET HEAT PUMP UNIT ON 4" THICK CONCRETE PAD. ROUTE 1/2" RL, 7/8" RS TO FAN COIL UNIT IN MECHANICAL ROOM.
7. EXISTING DUCTWORK IN CONTROL ROOM TO REMAIN.
8. REMOVE BLANK OFF PANEL FROM ORIGINAL RETURN AIR OPENING AND REPLACE WITH NEW GRILLE.
9. REMOVE EXISTING LAVATORY DRAIN CONNECTIONS. PLUG DRAIN PIPE AND RESTORE DRAIN CONNECTIONS. (TYP MENS AND WOMENS ROOMS)
10. REMOVE TOILET AND URINAL FIXTURES FROM MOUNTING, PLUG DRAIN PIPE AND RESET FIXTURES. (TYP MENS AND WOMENS ROOMS)
11. REMOVE SHOWER DRAIN STRAINER, PLUG PIPE AND REINSTALL STRAINER. (TYP MENS AND WOMENS ROOMS)
12. APPLY PVC COVERING TO ASBESTOS INSULATION ON PIPING BELOW +/- 8' ABOVE FLOOR THIS AREA.

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENG'R	ENG'R CHK	QA	B&W PROJ ENG'R

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FEASIBILITY ASSESSMENT PHASE II
MECHANICAL FLOOR PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDM0051.DWG

	TASK	DRAWING NO.	REV. NO.
HANFORD	100B	0100B-DD-M0051	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84553	105-B	8900

DRAWING NO.	REV. NO.
0100B-DD-M0052	NOTED

SPLIT SYSTEM AIR CONDITIONER UNIT SCHEDULE

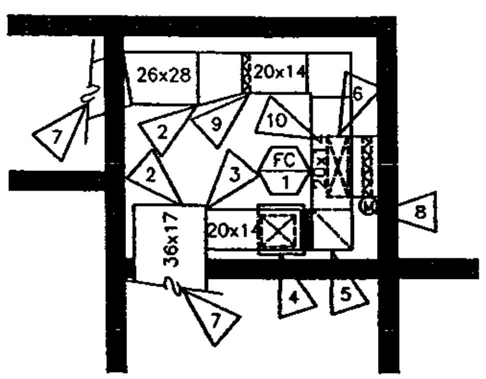
SYMBOL	MANUFACTURER	MODEL	TOTAL COOLING		EER	ENT. AIR CONDENSER	HEATING CAPACITY		OPER. WT.	CFM	EST. S.P.	VOLT/ø	ACCESSORIES/REMARKS
			OUTPUT	UNITS			INPUT	UNITS					
CU-1	LENNOX	12ACB60	58	MBTUH	12.6	95	–	MBTUH	250	–	–	208/3	C23-51/65 FC COOLING COIL
FC-1	LENNOX	G23Q5/6-150	–	MBTUH	–	–	150	MBTUH	250	2050	0.5	115/1	

EXHAUST FAN SCHEDULE

SYMBOL	MANUFACTURER	MODEL	CFM	S.P. EST.	VOLTS/ø	FAN RPM	MOTOR H.P.	ACCESSORIES/REMARKS
EF-1	GREENHECK	S1-12-432-D	1000	0.25	115/1	1550	1/8	.
.	.	.	.	.	.	.	.	.

ELECTRIC HEATER SCHEDULE

SYMBOL	MANUFACTURER	MODEL	HEATING CAPACITY		VOLTS/ø	ACCESSORIES/REMARKS
			OUTPUT	UNITS		
UH1	BRASCH	BTUH-5-2403	5	KW	208/3	:
UH2	BRASCH	BTUH-15-2083	15	KW	208/3	:
UH3	BRASCH	BTUH-15-2083	15	KW	208/3	:



ENLARGED PLAN
SCALE: 1/4" = 1'-0"

NOTES

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Rev. 0

FLAG NOTES

1. REMOVE EXISTING THROUGH THE WALL AIR CONDITIONING UNIT AND DUCTWORK AND REPLACE WITH LOUVER FULL SIZE OF EXISTING WALL OPENING.
2. BLANK OFF EXISTING DUCTWORK.
3. TIE NEW DUCTWORK INTO EXISTING DUCTWORK.
4. RISE AT UNIT DISCHARGE SIZE TO BOTTOM OF 20x14. PROVIDE FLEXIBLE CONNECTION AT UNIT CONNECTION.
5. DROP ALONG SIDE OF UNIT AT INLET OPENING WIDTH SIZE. PROVIDE FILTER RACK AND FLEXIBLE CONNECTION AT UNIT CONNECTION.
6. RISE AT LOUVER WIDTH BY 12" TO BOTTOM OF 20x14.
7. EXISTING CONTROL ROOM DUCTWORK TO REMAIN.
8. MOTORIZED DAMPER.
9. MANUAL DAMPER.
10. MANUAL DAMPER IN RISE.

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	CRID/ ENG'R	ENG'R CHK	CS	BHI PROJ ENG'R
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SCALE

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FEASIBILITY ASSESSMENT PHASE II
MECHANICAL ENLARGED PLAN AND SCHEDULES

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDM0052.DWG

HANFORD	TASK	DRAWING NO.	REV. NO.
	100B	0100B-DD-M0052	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84554	105-B	8900

DRAWING NO.	REV. NO.
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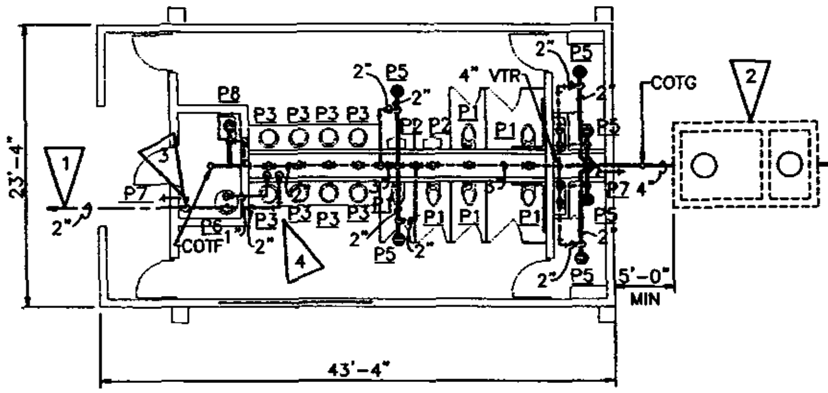
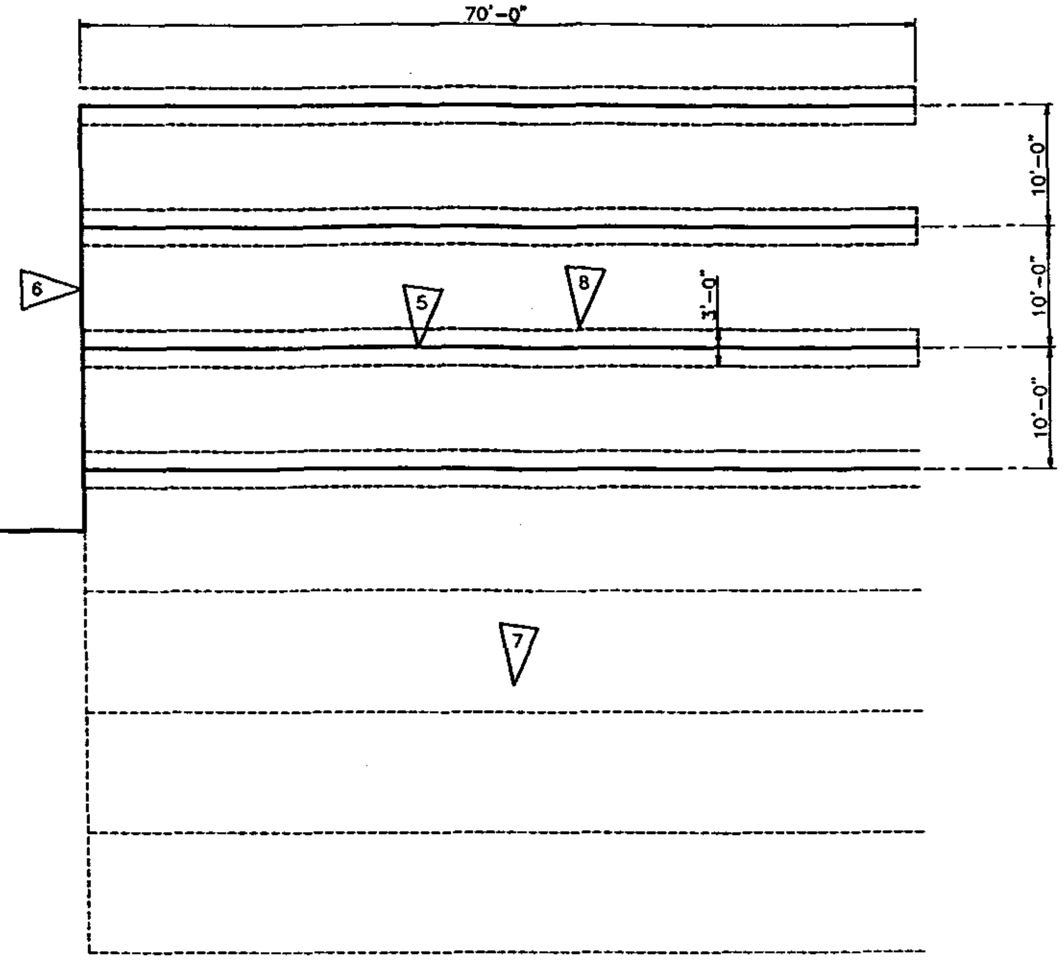
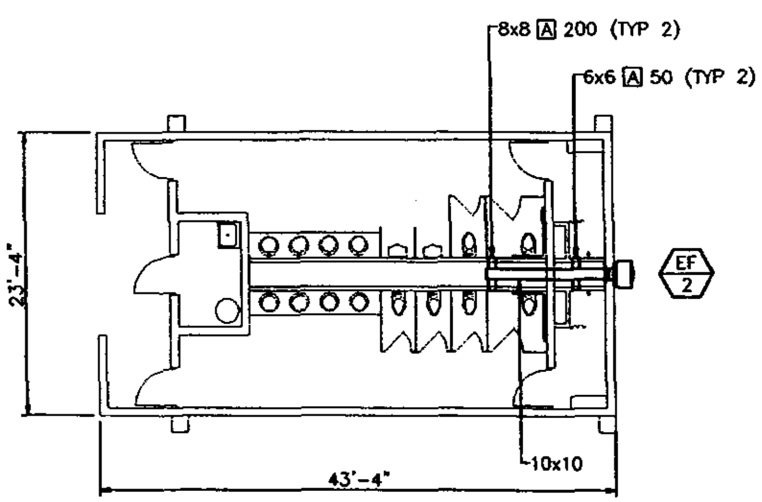




MECHANICAL PLUMBING PLAN

SCALE: 1/8" = 1'-0"



MECHANICAL HVAC PLAN

SCALE: 1/8" = 1'-0"

NOTES

1. HOT AND COLD WATER PIPING SHALL BE TYPE L COPPER TUBE WITH WROUGHT COPPER SOLDER FITTINGS AND LEAD-FREE SOLDER. FABRICATE, INSTALL SUPPORT AND TEST IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE.
2. WASTE AND VENT PIPING SHALL BE ABS PLASTIC PIPE WITH SOLVENT CEMENT FITTINGS AND JOINTS. FABRICATE, INSTALL, SUPPORT AND TEST IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE.
3. PIPING INSULATION SHALL BE MOLDED GLASS FIBER INSULATION WITH ALL-PURPOSE JACKET. INSULATE HOT AND COLD WATER PIPING WITH 1" THICK INSULATION. RUNOUT PIPING LESS THAN 12'-0" LONG TO INDIVIDUAL FIXTURES MAY BE INSULATED WITH 1/2" THICK INSULATION.

FLAG NOTES

1. 2" CW FROM 100-B AREA EXPORT WATER UTILITY.
2. 1500 GALLON SEPTIC TANK.
3. 2" CW UP ON WALL WITH SHUTOFF VALVE IN RISE.
4. 2" CW, 1" HW DOWN IN PLUMBING CHASE TO FIXTURES. SEE FIXTURE SCHEDULE FOR INDIVIDUAL ROUGH-IN SIZES.
5. PERFORATED DRAINFIELD LATERAL WITH CLEANOUT PORT AT END (TYPICAL OF 4).
6. DISTRIBUTION HEADER.
7. DRAINFIELD EXPANSION AREA.
8. DRAINFIELD TRENCH.

LEGEND

— - —	COLD WATER
— - - —	HOT WATER
———	WASTE
- - - - -	VENT
COTF	CLEANOUT TO FLOOR
COTG	CLEANOUT TO GRADE
VTR	VENT THROUGH ROOF
P1	PLUMBING FIXTURE (SEE SCHEDULE)

EXHAUST FAN SCHEDULE

SYMBOL	MANUFACTURER	MODEL	CFM	S.P. EST.	VOLTS/Ø	FAN RPM	MOTOR H.P.	ACCESSORIES/REMARKS
EF-2	GREENHECK	GW-95-G	500	0.25	115/1	1300	1/12	SHUTTER DAMPER

REGISTER, GRILLE, DIFFUSER SCHEDULE

SYMBOL	TYPE	SERVICE	STYLE	INSTALLATION	MATERIAL	COLOR	DAMPER	MFR/MODEL	REMARKS
A	FIXED GRILLE	RETURN	42' DEFLECTION	FLANGE FRAME	ALUMINUM	WHITE	OPPOSED BLADE	TUTTLE & BAILEY A70D	

PLUMBING FIXTURE SCHEDULE

SYMBOL	MANUFACTURER	MODEL	FIXTURE	MOUNTING	H.W.	C.W.	W	V	COLOR	ACCESSORIES/REMARKS
P1	KOHLER	K-4330	WALL	FLOOR	-	1	4	2	WHITE	SLOAN REGAL 111XL FLUSH VALVE, K-4670-C SEAT. PROVIDE VBF-72-A1 TRAP PRIMER FOR 1 TOILET PER RESTROOM
P2	KOHLER	K-5016-T	URINAL	WALL	-	3/4	2	1 1/2	WHITE	SLOAN REGAL 186-1.5XL FLUSH VALVE.
P3	KOHLER	K-2202-4	LAVATORY	COUNTER	1/2	1/2	1 1/2	1 1/4	WHITE	SYMMONS S-90 FAUCET, OFFSET DRAIN AND TAILPIECE, P-TRAP, ANGLE STOP SUPPLIES, SUPPLY AND DRAIN INSULATED COVERS
P4	SYMMONS	96-1-295	SHOWER SET	WALL	1/2	1/2	-	-	CHROME	PRESSURE BALANCED MIXING VALVE WITH ADJUSTABLE STOP SCREW, NOZZLE-TYPE SHOWER HEAD.
P5	J.R. SMITH	2005-Y	FLOOR DRAIN	FLOOR	-	-	2	2	NICKEL BRONZE	ROUND STRAINER, TRAP PRIMER CONNECTION.
P6	A.O. SMITH	EES-120	WATER HEATER	FLOOR	3/4	3/4	-	-	-	120 GALLON STORAGE, (2) 4500W NON-SIMULTANEOUS ELEMENTS
P7	J.R. SMITH	5609QT	NON-FREEZE WALL HYDRANT	WALL	-	3/4	-	-	NICKEL BRONZE	VACUUM BREAKER
P8	STERN WILLIAMS	SBC-1700	SERVICE SINK	FLOOR	1/2	1/2	3	2	TERRAZO	T-10-VB FAUCET, T-35 HOSE AND WALL BRACKET, T-40 MOP HANGER

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ENG/ARCH CHK	CHK'R CHK	QE	BHI PROJ. ENG

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

BECHTEL HANFORD INC.
RICHLAND, WASHINGTON

MEIER Enterprises, Inc.
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B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
RESTROOM MECHANICAL FLOOR PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDM0053.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-M0053	0

RECORD INFORMATION

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H-1-84555	105-B	8510

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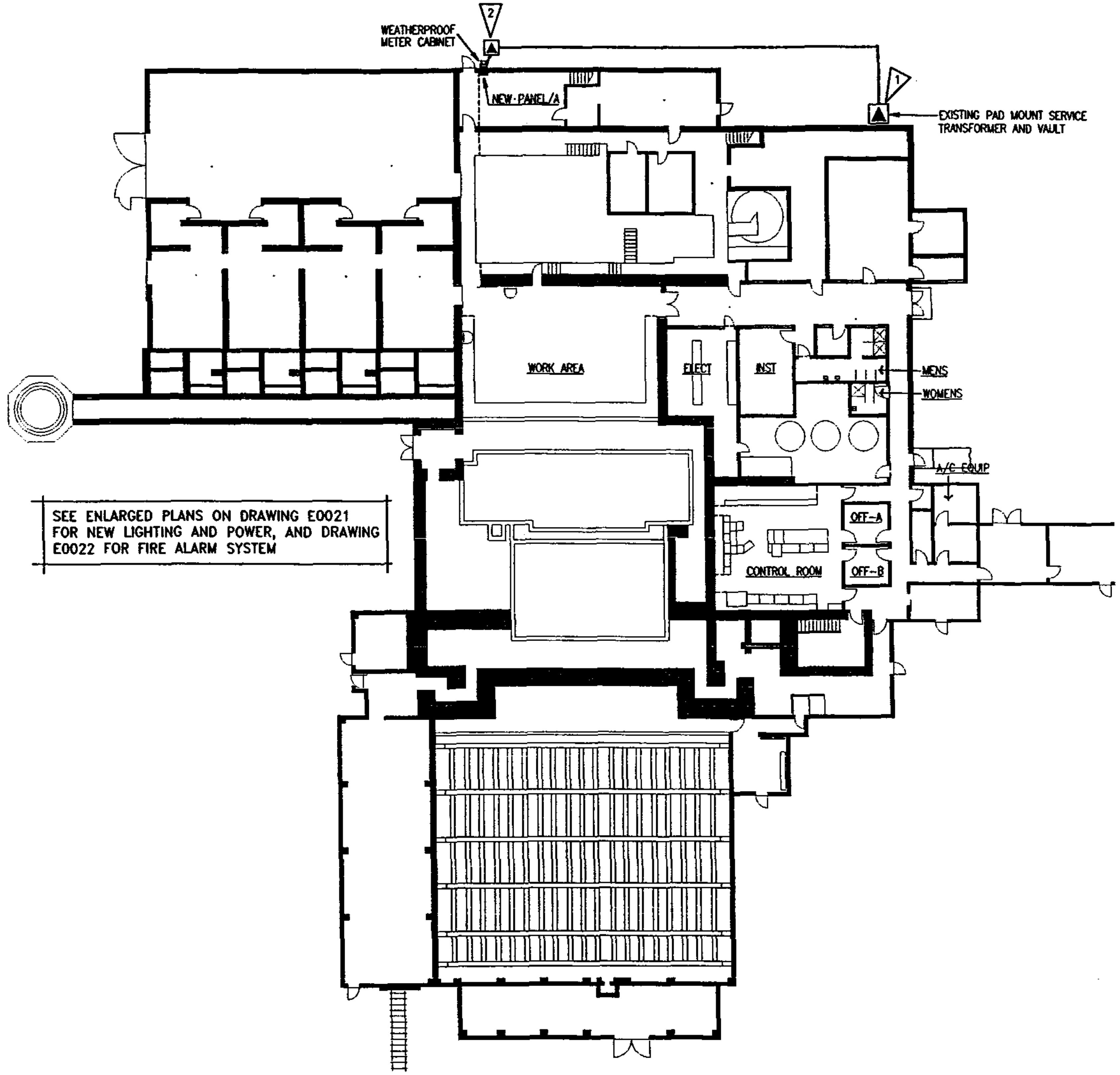

SEE ENLARGED PLANS ON DRAWING E0021 FOR NEW LIGHTING AND POWER, AND DRAWING E0022 FOR FIRE ALARM SYSTEM

OVERALL ELECTRICAL PLAN
SCALE: 1/16" = 1'-0"

LEGEND

⊗	LIGHTING FIXTURE (LETTER INDICATES FIXTURE TYPE)
	EM-EMERGENCY LIGHTING UNIT
⊖	DUPLEX RECEPTACLE, 125VAC, 20-AMP
=WM=	MULTI-OUTLET STRIP AS INDICATED
Ⓙ	JUNCTION BOX
	NON-FUSED DISCONNECT SWITCH
	FUSED DISCONNECT SWITCH
	TRANSFORMER
	ELECTRICAL PANEL-208Y/120V
	ELECTRICAL CONDUIT/WIRE RUN
	HOME RUN TO PANEL INDICATED
	DENOTES ELECTRICAL CONDUCTORS (NEUTRAL, HOT & GROUND RESPECTIVELY)
	UNDERGROUND CONDUIT RUN
AFF	ABOVE FINISH FLOOR
WP	WEATHERPROOF

FLAG NOTES.

1. EXISTING TRANSFORMER TO BE DE-ENERGIZED AND ABANDONED IN PLACE. EXISTING PRIMARY SERVICE TO BE EXTENDED TO NEW SERVICE TRANSFORMER INDICATED, SEE ONE-LINE DIAGRAM ON DRAWING E0023 FOR ADDITIONAL INFORMATION.
2. NEW PAD-MOUNTED TRANSFORMER-XTA, COORDINATE PAD AND ANY ADDITIONAL REQUIREMENTS WITH SITE UTILITY.

NOTES

1. THIS INSTALLATION SHALL COMPLY WITH THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE (NFPA-70, '99 EDITION).
2. ALL WORK SHALL BE DONE IN A NEAT AND WORKMANLIKE MANNER. ALL LABOR, MATERIAL, TOOLS, PERMITS, ETC. REQUIRED FOR A COMPLETE INSTALLATION SHALL BE FURNISHED BY THIS CONTRACTOR.
3. THE GENERAL ARRANGEMENT OF OUTLETS AND OTHER EQUIPMENT AS SHOWN ON THE PLANS IS DIAGRAMMATIC AND APPROXIMATELY CORRECT AS TO LOCATIONS. WHERE MINOR CHANGES ARE REQUIRED BECAUSE OF STRUCTURAL CONDITIONS OR FOR THE CONVENIENCE OF THE OWNER, SUCH CHANGES SHALL BE MADE AT THE CONTRACTORS EXPENSE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCURATE LOCATION OF ALL LIGHTING FIXTURES, OUTLETS, ETC. WITH RESPECT TO EQUIPMENT, DOORS, PARTITIONS, CABINETS, ETC.
4. ALL CONDUCTORS TO HAVE TYPE THWN/THHN INSULATION AND ARE NO.12 AWG UNLESS NOTED OTHERWISE. ALL CONDUITS SHALL HAVE A "GREEN" INSULATED GROUND WIRE INSTALLED WITH THE CONDUCTORS. THE GROUND WIRE SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND MAY NOT BE INDICATED ON THE PLANS. INSTALL A NYLON PULL TAPE OR ROPE IN ALL EMPTY CONDUIT.
5. MINIMUM CONDUIT SIZE SHALL BE 1/2" UNLESS OTHERWISE NOTED ON THE DRAWINGS. JUNCTION BOXES SHALL BE SIZED AND INSTALLED PER THE NATIONAL ELECTRICAL CODE.
6. JOINTS IN ALL CONDUIT INSTALLED IN CONCRETE, UNDERGROUND, OR EXPOSED TO WEATHER SHALL BE LIQUID TIGHT.
7. FURNISH AND INSTALL ALL LIGHTING FIXTURES IN ACCORDANCE WITH THE DATA SHOWN ON THE DRAWINGS, COMPLETE WITH SUPPORTS AND ALL NECESSARY AUXILIARIES. COORDINATE INSTALLATION WITH ARCHITECTURAL REFLECTED CEILING PLAN.
8. MOUNTING HEIGHTS SHALL BE AS FOLLOWS, UNLESS NOTED OTHERWISE:

   SWITCHES +46" OUTLETS +16" THERMOSTATS +60"

   ALL MOUNTING HEIGHTS ARE FROM FINISH FLOOR TO CENTER OF DEVICE OR LIGHTING FIXTURE.
9. TRENCHING THRU LANDSCAPED AREAS SHALL BE REPAIRED TO MATCH EXISTING CONDITION, INCLUDING CONCRETE WALKS AND CURBING. PROVIDE 3" YELLOW MARKING TAPE, TERRA TAPE OR EQUAL, PLACED DIRECTLY IN BACKFILL APPROXIMATELY 6" BELOW GRADE ABOVE ALL NEW UNDERGROUND CONDUIT.
10. UNDERGROUND CONDUIT TO BE PVC SCHEDULE 40, RAN MINIMUM 24" BELOW GRADE. TRANSITIONS FROM ABOVE GROUND TO BELOW GROUND RACEWAYS SHALL BE GALVANIZED RIGID STEEL(GRS). WRAP GRS CONDUIT WITH ALL-WEATHER CORROSION PROTECTION TAPE WHEN PASSING FROM ABOVE GROUND TO BELOW GROUND, 12" ABOVE GROUND TO 12" BELOW GROUND. TRANSITION SHALL OCCUR 12" BELOW GRADE LEVEL. IF CONDUIT IS RAN EXPOSED UNDER BUILDING IT SHALL BE GRS WRAPPED WITH PROTECTIVE TAPE OR PROVIDED WITH AN ASPHALTIC COATING. SEAL ALL CONDUIT PENETRATIONS WEATHER-TIGHT.

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENG'R	ENG'R CHK	QA	BHI PROJ ENG'R

SCALE:

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B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
OVERALL ELECTRICAL PLAN

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDE0020.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-E0020	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84556	105-B	7301,7401

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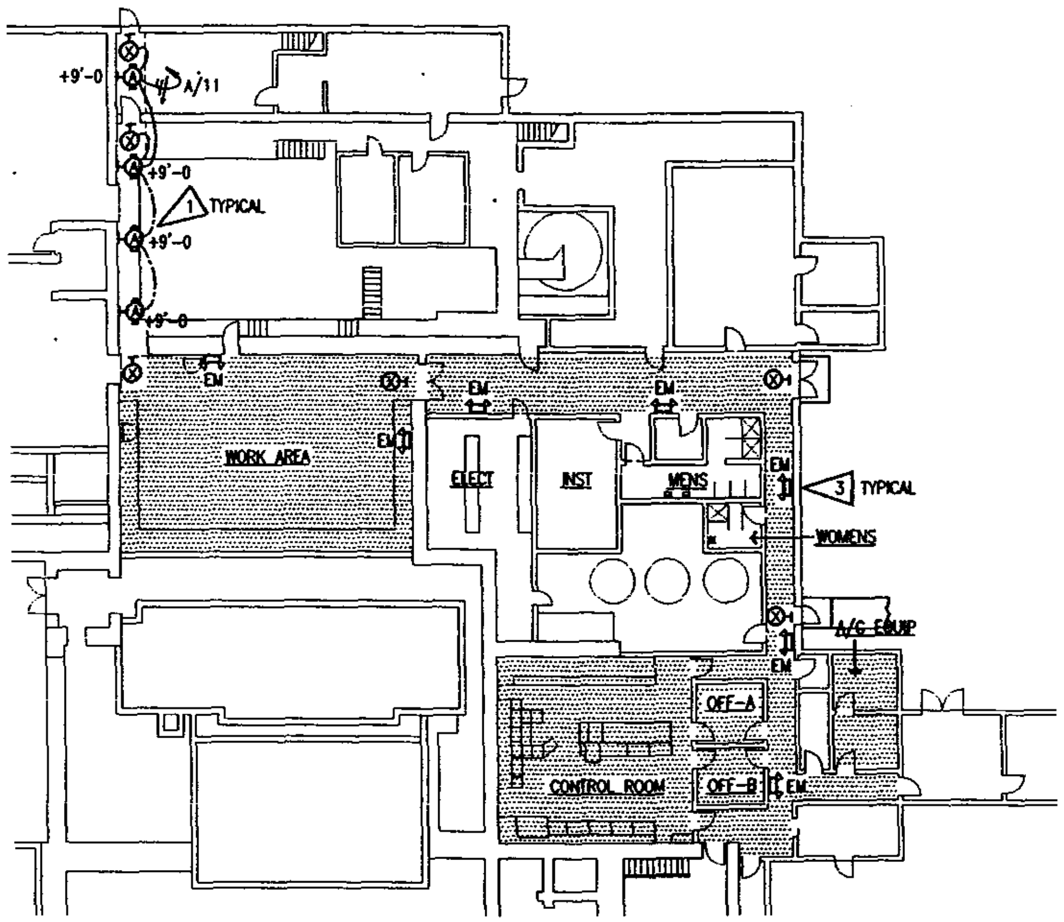
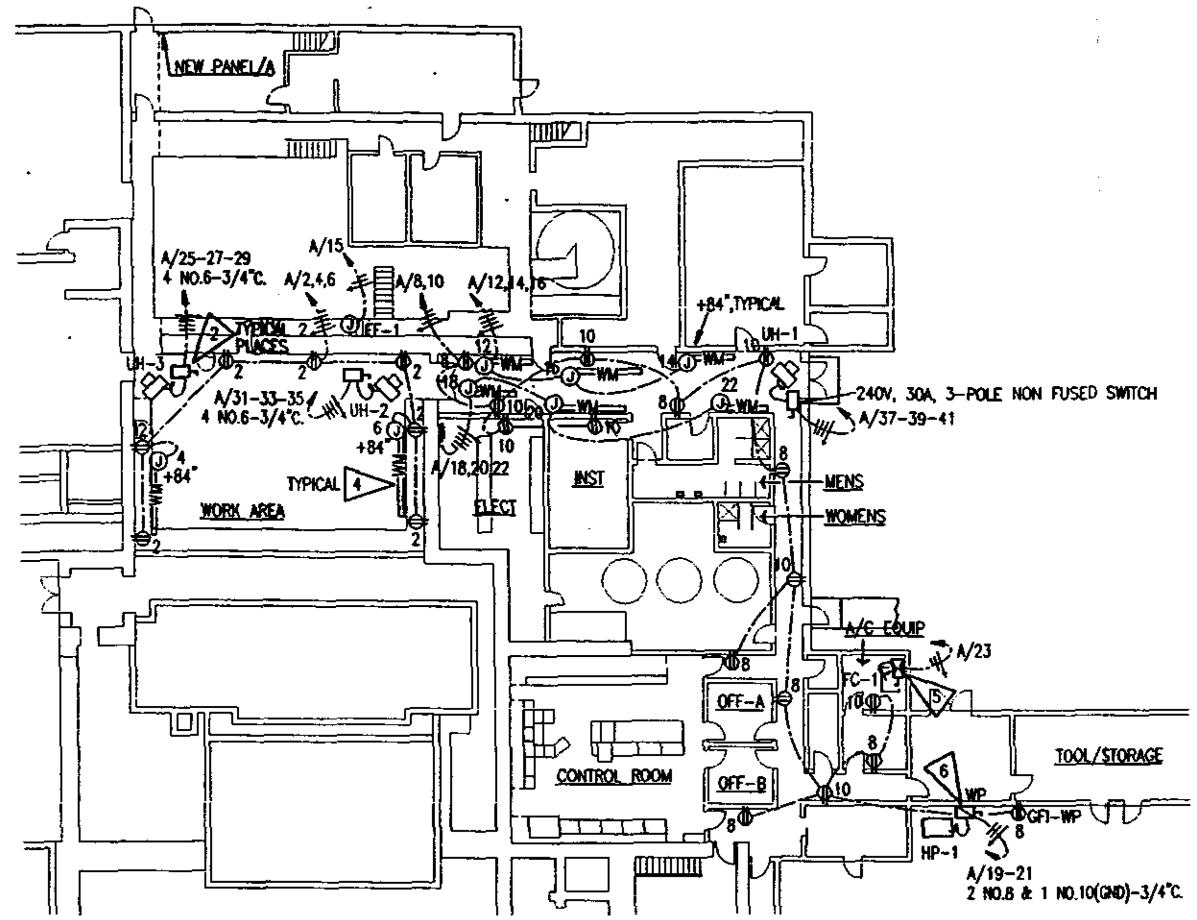
Rev. 0



HATCHING INDICATES AREAS IN WHICH EXISTING LIGHTING IS TO REMAIN. EXISTING CIRCUITRY SHALL BE REMOVED AND PROVIDED AS NEW FROM NEW PANEL/A. EXISTING RACEWAY STRUCTURE MAY BE RE-USED AS REQUIRED PROVIDED IT REMAINS IN OR IS RETURNED TO "MINT" CONDITION. PROVIDE CONDUIT EXTENSIONS, JUNCTION BOXES, CORE DRILLING, ETC. REQUIRED TO EXTEND NEW LIGHTING CIRCUITS BACK TO PANEL/A. ALL EXISTING LIGHTING FIXTURES AND SWITCHING SCHEMES ARE TO REMAIN AS THEY PRESENTLY EXIST SO AS NOT TO DISTURB THE AUTHENTICITY OF THIS STRUCTURE. ALL LIGHTING FIXTURES ARE TO BE CLEANED, RE-LAMPED AND LEFT IN COMPLETE WORKING ORDER. LIGHT SWITCHES THAT ARE NOT IN "MINT" CONDITION AND/OR ARE FOUND TO BE DEFECTIVE SHALL BE REPLACED. PROVIDE NEW COVER PLATES ON ALL SWITCHES INVOLVED WITH LIGHTING IN THIS INDICATED AREA.

FIRST FLOOR LIGHTING PLAN

SCALE: 1/16" = 1'-0"



FIRST FLOOR POWER PLAN

SCALE: 1/16" = 1'-0"

LIGHTING FIXTURE SCHEDULE

SYM	MANUFACTURER NAME	MANUFACTURER CATALOG NO.	FIX VA	LAMP TYPE	MOUNTING	REMARKS
A	LITHONIA	WC 232 120 GEB PS1400	68	32W/T8	WALL	
EM	LITHONIA	ELM4N	30	12W/PAR36	WALL	UNITS TO BE CONNECTED TO AN UNSWITCHED "HOT" CIRCUIT OF THAT SAME AREA. MOUNT AT +10'-0 AFF
X	LITHONIA	LQM S W 1 G 120/277 ELN	5	GREEN LED	BACK	UNITS TO BE CONNECTED TO AN UNSWITCHED "HOT" CIRCUIT OF THAT SAME AREA. CENTER 1'-0 ABOVE DOOR

NOTES

SEE NOTES ON DRAWING E0020 FOR GENERAL ELECTRICAL NOTES AND LEGEND

FLAG NOTES

1. LIGHTING FIXTURE TYPE-A TO BE SWITCHED AS INDICATED AND PROVIDED WITH A SEPERATE UNSWITCHED "HOT" CIRCUIT FOR AN EMERGENCY POWER PACK AS INDICATED IN LIGHTING FIXTURE SCHEDULE.
2. 240V, 60A, 3-POLE, NON-FUSED UNIT HEATER SAFETY SWITCH. MOUNT RIGIDLY UP AT UNIT ELEVATION.
3. EMERGENCY(EM) LIGHTING UNITS TO BE MOUNTED DICSCRETELY UP AT ELEVATIONS INDICATED. SLIGHT LOCATION MODIFICATIONS MAY BE MADE WITHOUT THE ENGINEERS DIRECTION SO AS TO LOCATE A UNIT WHERE IT WOULD NOT BE AS OBTRUSIVE WHILE STILL LIGHTING THE EGRESS PATH TO REQUIRED LEVELS.
4. MULTI-OUTLET STRIP TO BE EQUAL TO WIREMOLD NM2000 NONMETALIC, TWO-PIECE SURFACE RACEWAY WITH 20A DUPLEX OUTLETS AT 12" ON CENTER WITH GB-SERIES (SINGLE CIRCUIT) WIRING CONFIGURATION. LENGTHS TO BE AS INDICATED ON DRAWING.
5. COMBINATION STARTER/DISCONNECT WITH OVERLOADS FOR FRACTIONAL HORSEPOWER, 115V FAN COIL. MOUNT RIGIDLY AS REQUIRED AND MAKE ALL FINAL POWER CONNECTIONS, CONTROL WIRING AND DEVICES TO BE BY MECHANICAL.
6. 240V, 60A, 2-POLE DISCONNECT SWITCH WITH 35A FUSES FOR HEAT PUMP (HP)-1. MOUNT RIGIDLY AS REQUIRED AND MAKE ALL FINAL POWER CONNECTIONS, CONTROL WIRING AND DEVICES TO BE BY MECHANICAL.

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ENG/ARCH	ENG'R CHK	CS	BH PROJ ENG'R

SCALE:

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

BECHTEL HANFORD INC.
RICHLAND, WASHINGTON

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B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
ELECTRICAL FLOOR PLANS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDE0021.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-E0021	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84557	105-B	7301,7401

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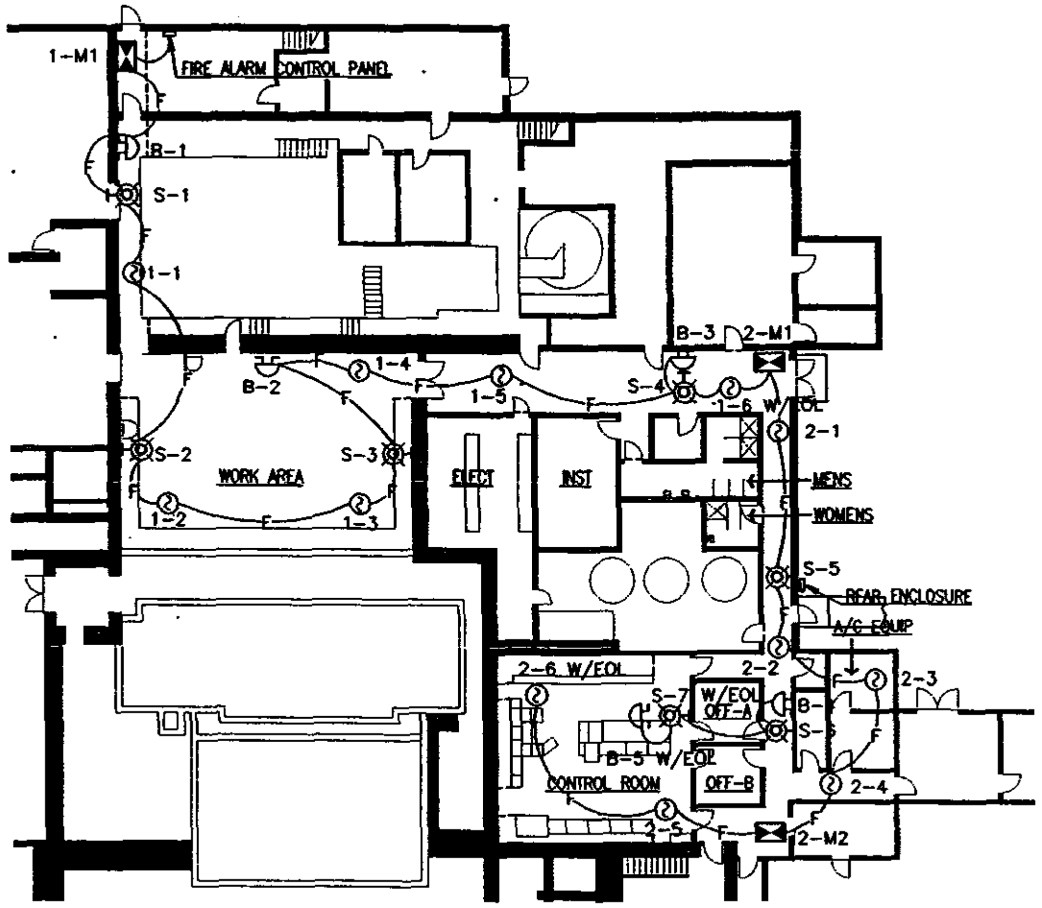
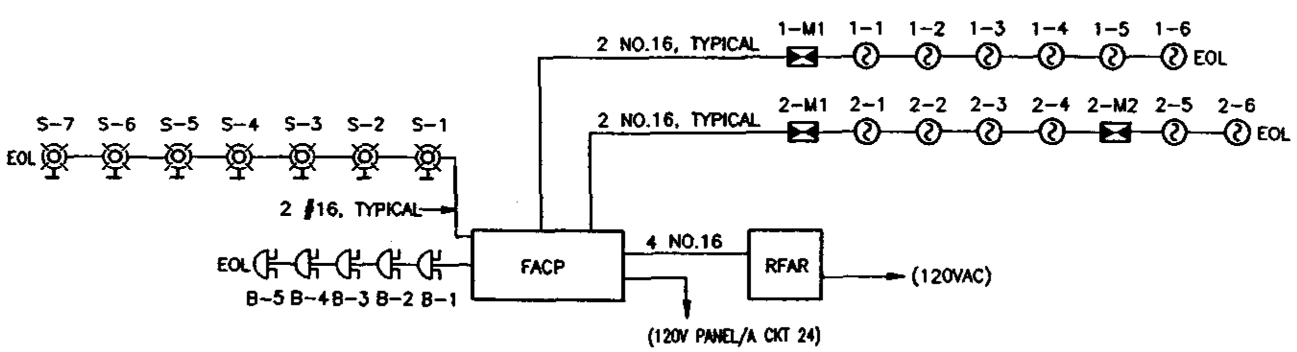
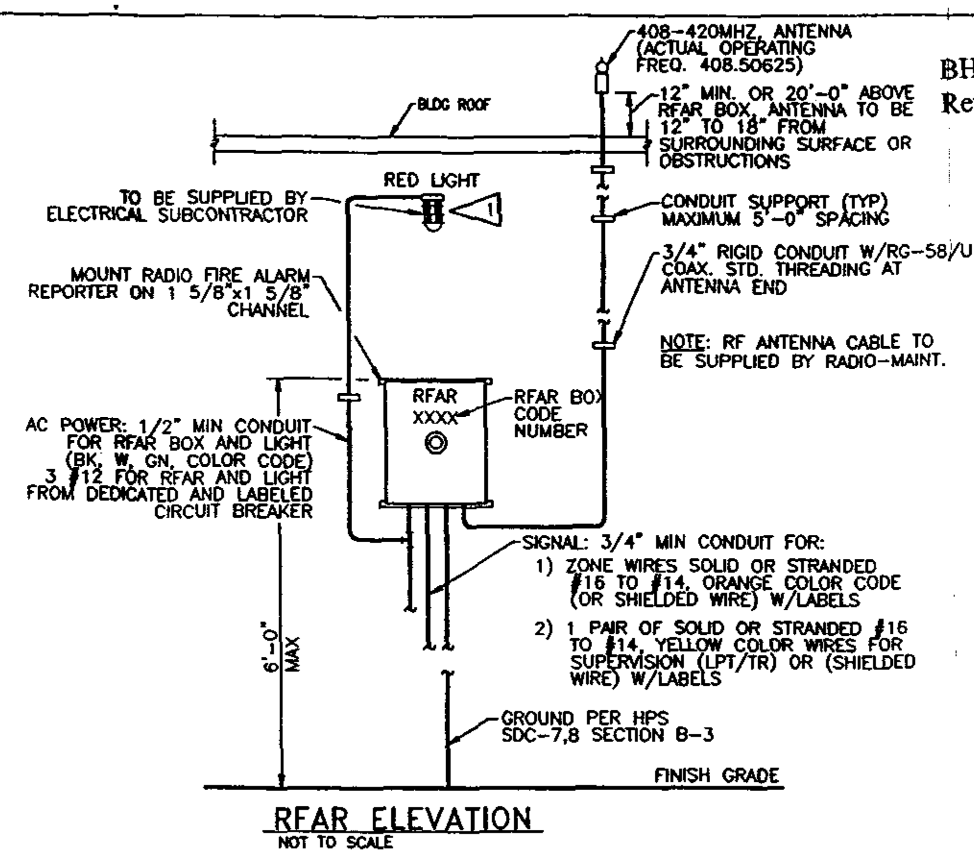
Rev. 0



FIRE ALARM PLAN
SCALE: 1/16" = 1'-0"



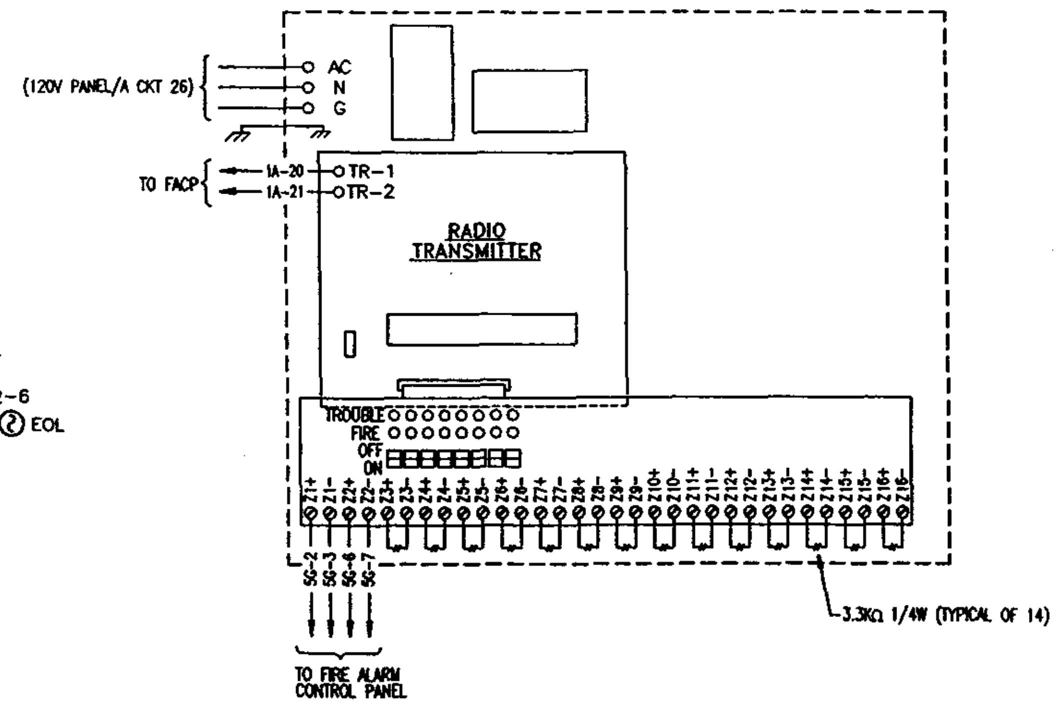
FIRE ALARM RISER
NO SCALE



RFAR ELEVATION
NOT TO SCALE

RFAR NOTES:

1. ELECTRONICS PACKAGE TO BE INSTALLED AND TESTED BY RADIO MAINTENANCE DURING THE OPERATIONAL TEST.
2. INSTALL ALL CONDUIT WITH WATER TIGHT FITTINGS AT THE BOTTOM, WITHIN 2 1/2" FROM THE BACK OF THE RFAR BOX.
3. ALL CONDUITS AND ENTRY WAYS TO BE PLUGGED AND SEALED.



RADIO FIRE ALARM REPORTER (RFAR)
NO SCALE

NOTES

SEE NOTES ON DRAWING E0020 FOR GENERAL ELECTRICAL NOTES AND LEGEND

FLAG NOTES

1. RADIO FIRE ALARM REPORTER INDICATING LIGHT, SURFACE MOUNT TO EXTERIOR WALL AS INDICATED. FIXTURE TO BE EQUAL TO CROUSE-HINDS CATALOG NO. VXHBF25GP WITH 60 WATT A-19 LAMP AND GUARD. SUBSTITUTE RED NO. G57 GLOBE.

LEGEND

(symbol)	FIRE ALARM MANUAL PULL STATION
(symbol)	SMOKE DETECTOR PHOTOELECTRIC
(symbol)	FIRE ALARM BELL
(symbol)	FIRE ALARM STROBE
(symbol)	HOME RUN TO RESPECTIVE SYSTEM PANEL
—F—	FIRE ALARM SYSTEM CONDUIT
FACP	FIRE ALARM CONTROL PANEL
RFAR	RADIO FIRE ALARM REPORTER
EOL	END OF LINE DEVICE

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ DSGN CHK	ENG'R CHK	QA	BHI PROJ ENG'R

SCALE:

U.S. DEPARTMENT OF ENERGY
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FEASIBILITY ASSESSMENT PHASE II
FIRE ALARM PLAN AND DIAGRAMS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDE0022.DWG

	TASK	DRAWING NO.	REV. NO.
HANFORD	100B	0100B-DD-E0022	0

RECORD INFORMATION

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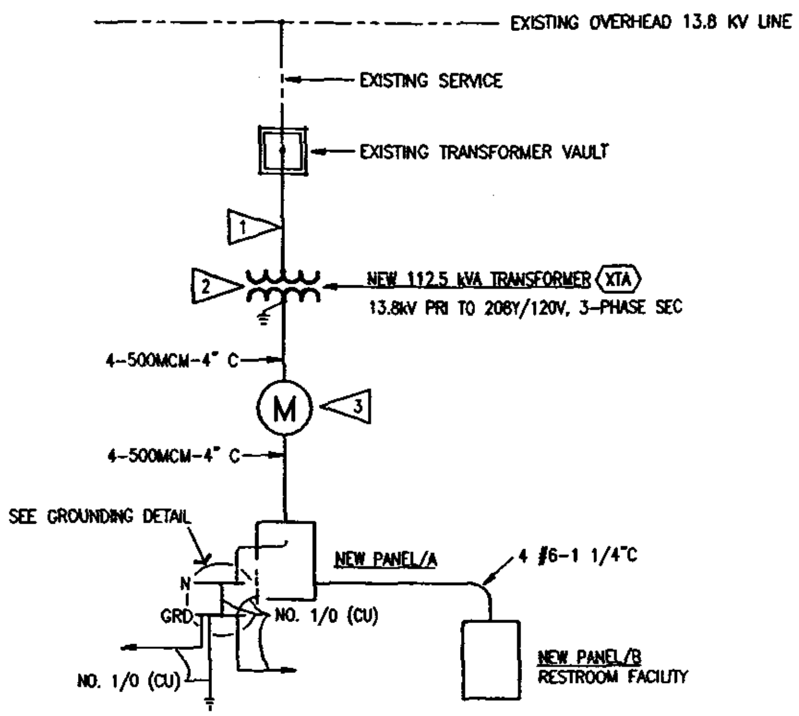
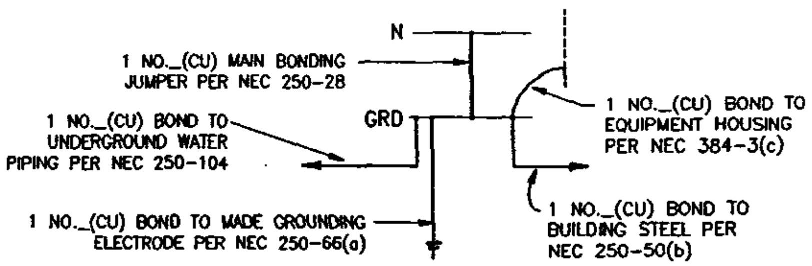


ONE-LINE DIAGRAM

SCALE: NONE



NOTE: REFER TO ONE-LINE FOR CONDUCTOR SIZES

GROUNDING DETAIL

SCALE: NONE

PANEL A

VOLTAGE : 208Y/120V, 3-PHASE, 4-WIRE
AMPERES : 400 MAIN BRKR : 400 AIC : 10,000
LUGS : BOTTOM MOUNTING : SURFACE
HEIGHT : 53" WIDTH : 20" DEPTH : 5-3/4"
FEEDERS/CONDUIT: SEE ONE-LINE DIAGRAM
TYPE : SQUARE-D~NQOD

CIRCUIT DESCRIPTION	P	BKR	#	ØA	ØB	ØC	#	BKR	P	CIRCUIT DESCRIPTION
LIGHTING (WORK AREA)	1	20	1	(1500) 1260			2	20	1	RECEPTACLES (WORK AREA)
LIGHTING (WORK AREA)	1	20	3		(1500) 1800		4	20	1	WIREMOLD (WORK AREA)
LIGHTING (CONTROL ROOM)	1	20	5			(1500) 1800	6	20	1	WIREMOLD (WORK AREA)
LIGHTING (OFFICE)	1	20	7	(1500) 1440			8	20	1	RECEPTACLES (CORRIDOR, GEN.)
LIGHTING (CORRIDOR)	1	20	9		(1500) 1440		10	20	1	RECEPTACLES (CORRIDOR, GEN.)
LIGHTING (CORRIDOR)	1	20	11			(1500) 1440	12	20	1	WIREMOLD (CORRIDOR)
LIGHTING (A/C EQUIP. ROOM)	1	20	13	(1500) 1440			14	20	1	WIREMOLD (CORRIDOR)
EXHAUST FAN (EF)-1 1/8HP	1	20	15		345 1800		16	20	1	WIREMOLD (CORRRIDOR)
SPARE	1	20	17			1920 1440	18	20	1	WIREMOLD (CORRIDOR)
HEAT PUMP (HP)-1	2	35	19	(2919) 1800			20	20	1	WIREMOLD (CORRIDOR)
	-	-	21		(2912) 1440		22	20	1	WIREMOLD (CORRRIDOR)
FAN COIL (FC)-1 1/2HP	1	20	23			(1127) 800	24	20	1	FIRE ALARM CONTROL PANEL
UNIT HEATER (UH)-3 15kW	3	60	25	5000 800			26	20	1	FIRE ALARM REPORTER
	-	-	27		5000 1920		28	20	1	SPARE
	-	-	29			5000 1920	30	20	1	SPARE
UNIT HEATER (UH)-2 15kW	3	60	31	5000 1920			32	20	1	SPARE
	-	-	33		5000		34			SPACE
	-	-	35			5000	36			
UNIT HEATER (UH)-1 5kW	3	20	37	1667			38			
	-	-	39		1667 (9169)		40	100	2	RESTROOM BUILDING
	-	-	41			1667 (8495)	42	-	-	
TOTAL VOLT-AMPS				27739	35493	33609	REMARKS:			
TOTAL CONNECTED LOAD:				96.84 KVA	268.80 AMPS					
TOTAL DEMAND LOAD:				85.32 KVA	236.83 AMPS					

NOTES

SEE NOTES ON DRAWING E0020 FOR GENERAL ELECTRICAL NOTES AND LEGEND.

FLAG NOTES

1. EXISTING SERVICE TRANSFORMER TO BE DE-ENERGIZED. EXISTING 13.8 KV PRIMARY SERVICE TO BE EXTENDED UNDERGROUND FROM TRANSFORMER VAULT VIA MINIMUM 2"-4" CONCRETE ENCASED CONDUIT TO NEW SERVICE TRANSFORMER. COORDINATE EXACT REQUIREMENTS WITH SITE UTILITY. SEE DRAWING E0020 FOR ADDITIONAL INFORMATION.
2. TRANSFORMER TO BE PAD MOUNTED PER SITE UTILITY REQUIREMENTS WHERE INDICATED ON DRAWING E0020.
3. NEW WALL MOUNTED, LINE-VOLTAGE METER CABINET PER SITE UTILITY REQUIREMENTS, SEE DRAWING E0020 FOR LOCATION.

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENGR CHK	ENGR CHK	QA	BHI PROJ ENGR

SCALE:

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

BECHTEL HANFORD INC.
RICHLAND, WASHINGTON

MEIER Enterprises, Inc.

B REACTOR MUSEUM
FEASIBILITY ASSESSMENT PHASE II
ONE-LINE DIAGRAM & PANELS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDE0023.DWG

TASK	DRAWING NO.	REV. NO.
100B	0100B-DD-E0023	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
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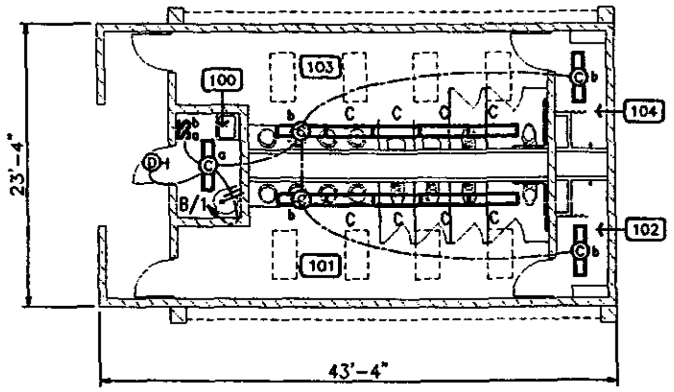
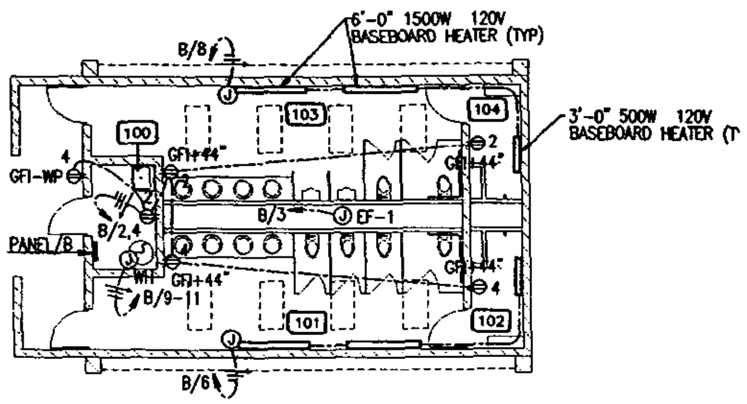


LIGHTING PLAN
SCALE: 1/8" = 1'-0"



POWER PLAN
SCALE: 1/8" = 1'-0"

PANEL B

VOLTAGE : 208/120V, 1-PHASE, 3-WIRE
AMPERES : 100 MAIN BRKR : 100 AIC : 10,000
LUGS : BOTTOM MOUNTING :
HEIGHT : WIDTH : DEPTH :
FEEDERS/CONDUIT:
TYPE : SQUARE-D~QO LOAD CENTER

CIRCUIT DESCRIPTION	P	BKR	CIR	ØA	ØB	CIR	BKR	P	CIRCUIT DESCRIPTION
LIGHTING (GENERAL)	1	20	1	959 / 540		2	20	1	RECEPTS. (GENERAL)
EXHAUST FAN EF-1	1	20	3		285 / 540	4	20	1	RECEPTS. (GENERAL)
SPARE	1	20	5	1920 / 3500		6	30	1	RM 101 & 102 BASEBOARD HEATERS
SPARE	1	20	7		1920 / 3500	8	30	1	RM 103 & 104 BASEBOARD HEATERS
WATER HEATER	2	30	9	2250		10			SPACE
	-	-	11		2250	12			↓
TOTAL VOLT-AMPS				9169	8495				REMARKS:
TOTAL CONNECTED LOAD: 17.66 KVA 84.92 AMPS									
TOTAL DEMAND LOAD: 13.82 KVA 66.46 AMPS									

LIGHTING FIXTURE SCHEDULE

SYM	MANUFACTURER NAME	MANUFACTURER CATALOG NO.	FIX VA	LAMP TYPE	MOUNTING	REMARKS
C	KENNALL	N1048C-2-32-EB-1-120	68	32W/T8	SURF	
D	KENNALL	MR17EL-P-MB70M-1-120	75	70W/MH	WALL	W/ PHOTOCELL

NOTES

SEE NOTES ON DRAWING E0020 FOR GENERAL ELECTRICAL NOTES AND LEGEND

REV.	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	ORIG/ENGR	ENGR CHK	QA	BH PROJ ENGR
△								
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△								
△								

SCALE:

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
RICHLAND ENVIRONMENTAL RESTORATION PROJECT

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FEASIBILITY ASSESSMENT PHASE II
ELECTRICAL RESTROOM FLOOR PLANS

BECHTEL JOB NO.	DOE CONTRACT NO.	CADD FILENAME
22192	DE-AC06-93RL12367	1BDE0024.DWG

HANFORD	TASK	DRAWING NO.	REV. NO.
	100B	0100B-DD-E0024	0

RECORD INFORMATION

RECORD NO.	BLDG NO.	INDEX NO.
H-1-84560	105-B	7301.7401

MEIER Enterprises, Inc.
Construction Cost Estimate

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0

Date: 6/16/00
Prepared by: RDR
Checked by:

CONSTRUCTION SUMMARY

CSI DIVISION	DESCRIPTION		TOTAL
1	GENERAL REQUIREMENTS		$37,753
2	SITE WORK		$4,996
3	CONCRETE		$8,979
4	MASONRY		$22,930
5	METALS		$4,510
6	WOOD & PLASTICS		$5,408
7	THERMAL & MOISTURE PROTECTION		$3,158
8	DOORS & WINDOWS		$26,895
9	FINISHES		$29,928
10	SPECIALTIES		$7,868
11	EQUIPMENT		$0
12	FURNISHINGS		$0
13	SPECIAL CONSTRUCTION:		$27,561
14	CONVEYING SYSTEMS		$0
15	MECHANICAL:		
15.1	PLUMBING		$50,494
15.2	HVAC		$32,627
16	ELECTRICAL		$147,476
17	CONTROLS		$13,639
	SUBTOTAL		$424,224
	TAX	8.00%	$33,938
	BOND & INSURANCE	1.50%	$6,872
	CONTINGENCY	5.00%	$23,252
	TOTAL		$488,286

CONSTRUCTION SUMMARY BY SUBPROJECT

SUBPROJECT	DESCRIPTION		TOTAL
	GENERAL REQUIREMENTS		$37,753
SP 1	RESTROOM BUILDING		$123,981
SP 2	VENTILATION UPGRADES		$41,765
SP 3	EMERGENCY EXIT/FIRE PROTECTION UPGRADES		$102,555
SP 4	ELECTRICAL UPGRADES		$118,169
	SUBTOTAL		$424,224
	TAX	8.00%	$33,938
	BOND & INSURANCE	1.50%	$6,872
	CONTINGENCY	5.00%	$23,252
	TOTAL		$488,286

Note: Estimate quantities are based on field walk-through evaluations and on quantities shown on design drawings. Estimate amounts are based on Means pricing data.

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 1: GENERAL REQUIREMENTS | Checked by:

DESCRIPTION	QTY	UNIT	MAN-HOURS UNIT	MAN-HOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
SUBMITTAL DOCUMENTS	0	MH	1		40						
CONSTRUCTION MANAGER	240	MH	1	240	60	14400					$14,400
SECRETARIAL STAFF	0	MH	1		45						
GENERAL FOREMAN	320	MH	1	320	50	16000					$16,000
CONSTRUCTION TRAILERS	2	MO							800		$800
RESTROOM FACILITIES	2	MO							170		$170
TELEPHONE	0	MO									
GARBAGE DUMPSTERS	6	WK							300		$300
SMALL TOOLS	1	GRP							1000		$1,000
SUBTOTAL				560		30400			2270		$32,670

GENERAL CONTRACTOR'S MARKUPS:

OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$2,432
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$182
PROFIT	7.0%	$2,470
DIVISION 1 TOTAL		$37,753

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 2: SITE WORK (SUBPROJECT 1)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QTY	UNIT	MAN-HOURS UNIT	MAN-HOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
SITE PREPARATION											
CLEAR AND GRUB (SAGE)	0.5	AC	100	50	25.68	1284			725		$2,009
GENERAL GRADING, DOZER	403.333	CY							250	1412	$1,662
BLDG SITE ROUGH GRADE	27.7778	CY							250	139	$389
EARTHWORK											
CONT. FOOTINGS (EXCAVATION)	44.3333	CY	0.10435	4.626	29.58	137			68		$205
COLUMN FOOTINGS (EXCAVATION)	0	CY	0.14026		29.58						
STRUCTURAL BACKFILL AND COMPACTION	17.7333	CY	0.2093	3.7116	29.58	110			28		$138
SUBTOTAL				58.338		1531			1321.203	1550.55556	$4,403

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$122
OVERHEAD EQUIPMENT & SUBCONTRACTOR	5.0%	$144
PROFIT	7.0%	$327
DIVISION 2 TOTAL		$4,996

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 3: CONCRETE (SUBPROJECT 1)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QT.	UNIT	MAN-HOURS UNIT	MAN-HOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
CONT. PERIMETER FOOTINGS	133	LF									
FORMWORK (24w12d)	266	SFCA	0.066	17.556	29.30	514	0.43	114	16		$644
REINFORCEMENT	416.157	#	0.0076	3.1628	29.23	92	0.28	117			$209
CONCRETE PLACEMENT	9.85185	CY	0.436	4.2954	29.23	126	65	640	6		$772
CONT. PERIMETER STEM WALL	133	LF									
FORMWORK	665	SFCA	0.095	63.175	29.30	1851	0.81	539	47		$2,437
REINFORCEMENT	499.334	#	0.00533	2.6631	29.23	78	0.28	140			$218
CONCRETE PLACEMENT	12.3148	CY	0.53	6.5269	29.23	191	65	800	10		$1,001
FINE GRADE FOR SLABS	18.7222	CY	0.15	2.8083	25.68	72			19		$91
INTERIOR SLABS 4"	1011	SF									
FORMWORK (not against walls)	0	LF	0.053		29.30		0.31				
4" 5/8 - CRUSHED ROCK	0	CY	0.4		29.23		8				
BAR REINFORCEMENT	675.348	#	0.007	4.7274	29.23	138	0.28	189			$327
CONCRETE	12.4802	CY	0.436	5.4414	29.23	159	65	811	9		$979
FINISHING	1011	SF	0.015	15.165	29.23	443			71		$514
VAPOR BARRIER	0	SF	0.0018		25.68		0.025				
SUBTOTAL				125.52		3664		3350	177.5112		$7,192

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$561
OVERHEAD EQUIPMENT & SUBCONTRACTOR	5.0%	$9
PROFIT	7.0%	$543
DIVISION 3 TOTAL		$8,305

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 3: CONCRETE (SUBPROJECT 3)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QT.	UNIT	MAN-HOURS UNIT	MAN-HOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS											
EXTERIOR CONCRETE PADS	100	SF								600	$600
SUBTOTAL										600	$600

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$0
OVERHEAD EQUIPMENT & SUBCONTRACTOR	5.0%	$30
PROFIT	7.0%	$44
DIVISION 3 TOTAL		$674

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 4: MASONRY (SUBPROJECT 1) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
STANDARD 8x8x16 BLOCK	2334.44	SF								19843	$19,843
SUBTOTAL										19842.7587	$19,843

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$0
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$1,587
PROFIT	7.0%	$1,500
DIVISION 4 TOTAL		$22,930

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 5: METALS (SUBPROJECT 3) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS											
modify grating to 1/2" max vert edge	2	allow	16	32	33	1056	150	300			$1,356
stl diamond plate deck on exist. Grating	200	sf								900	$900
add intermediate rails to stl guardrails	260	lf-rail	0.12308	32	36	1152	2	520			$1,672
SUBTOTAL				64		2208		820		900	$3,928

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$242
OVERHEAD EQUIPMENT & SUBCONTRACTOR	5.0%	$45
PROFIT	7.0%	$295
DIVISION 5 TOTAL		$4,510

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 6: WOOD & PLASTICS (SUBPROJECT 1) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
COUNTERTOP 24" deep	20	LF	0.5	10	29.30	293	30	600			$893
WOOD ROOF TRUSSES	1100	SF								3025	$3,025
5/8" ROOF SHEATHING	1100	SF	0.01	11	29.30	322	0.4	440			$762
SUBTOTAL				21		615		1040		3025	4680

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$132
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$242
PROFIT	7.0%	$354
DIVISION 6 TOTAL		$5,408

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00

Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR

DIVISION 7: THERMAL & MOISTURE PROTECTION (SUBPROJECT 1) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
New METAL Roofing	885	SF	0.0416	36.816	34.32	1264	1	885	27		$2,176
ridge closure	37	LF	0.043	1.591	34.32	55	3	111	1		$167
flashings, closures	74	LF	0.11	8.14	34.32	279	1.5	111			$390
SUBTOTAL				46.547		1598		1107	28.03		$2,733

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$216
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$2
PROFIT	7.0%	$207
DIVISION 7 TOTAL		$3,158

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 8: DOORS & WINDOWS (SUBPROJECT 1) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
H.M. STEEL DOORS AND P.M. FRAMES											
3' x 7' Including hardware	5	EA								4000	$4,000
SKYLIGHTS	120	SF	0.13333	16	29.30	469	20	2400			$2,869
SUBTOTAL				16		469		2400		4000	$6,869

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$230
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$320
PROFIT	7.0%	$519
DIVISION 8 TOTAL		$7,938

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 8: DOORS & WINDOWS (SUBPROJECT 3)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

			MANHOURS				MATERIAL				
DESCRIPTION	QTY	UNIT	UNIT	TOTAL	$/HR	LABOR	UNIT	TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS											
New Steel doors, hardware											
3' x 7' Including hardware	4	ea								6000	$6,000
6'x7' (pair) Including hardware	1	ea								1600	$1,600
existing doors to be set and locked in place	14	ea	0.25	3.5	30	105	50	700			$805
plexiglas shield door/access panels	16	ea								8000	$8,000
SUBTOTAL				3.5		105		700		15600	$16,405

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$64
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$1,248
PROFIT	7.0%	$1,240
DIVISION 8 TOTAL		$18,958

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 9: FINISHES (SUBPROJECT 1)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
3-1/2" LOAD BEARING METAL STUDS	433.5	SF	0.042	18.207	29.30	533	0.95	412			$945
5/8" TYPE-X GWB, T&T WALLS	433.5	SFW	0.017	7.3695	29.30	216	0.35	152			$368
5/8" TYPE-X GWB, T&T CEILINGS	851	SFW	0.026	22.126	29.30	648	0.35	298			$946
SEAL COAT ON CONCRETE FLOOR	851	SF								851	$851
PAINTING, WALLS, CEILINGS	1284.5	SF	0.018	23.121	29.30	677	0.11	141			$818
PAINTING, DOORS	10	EA	1.5	15	29.30	440	10	100			$540
SUBTOTAL				85.824		2514		1103		851	$4,468

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$289
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$68
PROFIT	7.0%	$338
DIVISION 9 TOTAL		$5,163

B-REACTOR PHASE II FEASIBILITY STUDY | **MEIER Enterprises, Inc.** | **Date:** 6/16/00
Job No. 3036.0 | **Construction Cost Estimate** | **Prepared by:** RDR
DIVISION 9: FINISHES | **Checked by:**

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS/FIRE PROTECTION											
remove flaking paint on equip in control room	1370	sf								4110	$4,110
remove flaking paint on walls (assume 50%)	6100	sf								6100	$6,100
paint equip in control room	1370	sf								1370	$1,370
paint walls	12200	sf								9150	$9,150
vct flooring mods	100	sf								700	$700
SUBTOTAL										21430	$21,430

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$0
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$1,714
PROFIT	7.0%	$1,620
DIVISION 9 TOTAL		$24,765

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 10: SPECIALTIES (SUBPROJECT 1)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
TOILET PARTITIONS											
STANDARD	6	EA	3	18	29.30	527	500	3000			$3,527
URINAL SCREENS	2	EA	2	4	29.30	117	250	500			$617
SIGNS	4	EA	0.25	1	29.30	29	10	40			$69
LOCKERS (72" SINGLE TIER)	0	EA	1		29.30		120				
BENCHES (3' MAPLE)	2	EA	2	4	29.30	117	150	300			$417
STORAGE SHELVING	6	EA	0.5	3	29.30	88	20	120			$208
TOILET ACCESSORIES											
PAPER TOWEL DISPENSER	2	EA	0.75	1.5	29.30	44	50	100			$144
WASTE RECEPTACLE	2	EA	1	2	29.30	59	174	348			$407
SHELF, METAL	0	EA	0.5		29.30		10				
SOAP DISPENSER	6	EA	0.75	4.5	29.30	132	54	324			$456
TOILET TISSUE DISPENSER	6	EA	0.375	2.25	29.30	66	27	162			$228
GRAB BARS	2	EA	0.5	1	29.30	29	40	80			$109
MIRRORS (4'x2')	0	EA	1		29.30		180				
MOP AND BROOM HOLDERS	2	EA	0.5	1	29.30	29	50	100			$129
TOILET COVER DISPENSER	2	EA	0.5	1	29.30	29	27	54			$83
HOOK STRIPS	2	EA	0.375	0.75	29.30	22	35	70			$92
SUBTOTAL				44		1288		5198			6486

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$519
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$0
PROFIT	7.0%	$490
DIVISION 10 TOTAL		$7,495

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 10: SPECIALTIES (SUBPROJECT 3) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS/FIRE PROTECTION											
FIRE EXTINGUISHERS	5	EA	0.5	2.5	29.30	73	50	250			$323
SUBTOTAL				2.5		73		250			323

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$26
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$0
PROFIT	7.0%	$24
DIVISION 10 TOTAL		$373

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 13: SPECIAL CONSTRUCTION (SUBPROJECT 3) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS/FIRE PROTECTION											
Removal of fixed contamination	1	job	160	160	65.00	10400			200		$10,600
Disposal	2	drum					50	100			$100
Decontamination of tube bundles	1	job	120	120	65.00	7800					$7,800
Disposal	2	drum					50	100			$100
Lead-based paint removal	1	job	80	80	65.00	5200					$5,200
Disposal	1	drum					50	50			$50
SUBTOTAL				360		23400		250	200		$23,850

GENERAL CONTRACTOR'S MARKUPS:		
OVERHEAD LESS EQUIPMENT & SUBCONTRACTOR	8.0%	$1,892
OVERHEAD EQUIPMENT & SUBCONTRACTOR	8.0%	$16
PROFIT	7.0%	$1,803
DIVISION 13 TOTAL		$27,561

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00

Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR

DIVISION 15: MECHANICAL (SUBPROJECT 1) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
Water Closet	6	ea	11.875	71.25	40.00	2850	665	3990			$6,840
Urinal	2	ea	13	26	40.00	1040	395	790			$1,830
Lavatory	8	ea	12.125	97	40.00	3880	335	2680			$6,560
Shower	2	ea	16.625	33.25	40.00	1330	425	850			$2,180
Hose Bibb	2	ea	0.571	1.142	40.00	46	153	306			$352
Water Heater	1	ea	26.25	26.25	40.00	1050	1400	1400			$2,450
Floor Drain	4	ea	1.33	5.32	40.00	213	60	240			$453
2" Type K Copper	300	lf	0.2	60	40.00	2400	4.9	1470			$3,870
2" Type L Copper w/insulation	50	lf	0.27	13.5	40.00	540	5.82	291			$831
1" Type L Copper w/insulation	50	lf	0.191	9.55	40.00	382	3.24	162			$544
4" ABS	50	lf	0.333	16.65	40.00	666	4.44	222			$888
3" ABS	25	lf	0.302	7.55	40.00	302	3.28	82			$384
2" ABS	25	lf	0.271	6.775	40.00	271	2.91	73			$344
Septic System	1	ea	60.9375	60.938	40.00	2438	2156	2156			$4,594
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$8,351
PROFIT 10% (L,M,E,SC)											$3,212
PLUMBING SUBCONTRACTOR TOTAL				435.17		17408		14712			$43,683
GENERAL CONTRACTOR'S MARKUPS:											
PROFIT ON SUBCONTRACT					5%						$2,184
DIVISION 15 - PLUMBING TOTAL											$45,867

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 15: MECHANICAL (SUBPROJECT 3) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS/FIRE PROTECTION											
Demolition of floor drains, plugging existing fixture piping	1	job	40	40	40.00	1600	500	500			$2,100
Piping insulation coverings	1	job	16	16	40.00	640	500	500			$1,140
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$842
PROFIT 10% (L,M,E,SC)											$324
PLUMBING SUBCONTRACTOR TOTAL				56		2240		1000			$4,406
GENERAL CONTRACTOR'S MARKUPS:											
PROFIT ON SUBCONTRACT					5%						$220
DIVISION 15 - PLUMBING TOTAL											$4,627

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 15: MECHANICAL (SUBPROJECT 1)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
RESTROOM BUILDING											
Exhaust Fan	1	ea	1.25	1	40	50	305	305			$355
Grilles	4	ea	0.308	1	40	49	12	49			$98
Sheet Metal Ductwork	100	lb	0.102	10	40	408	1.05	105			$513
Controls	1	job	4	4	40	160	500	500			$660
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$423
PROFIT 10% (L,M,E,SC)											$163
PLUMBING SUBCONTRACTOR TOTAL				16.682		667		959			$2,211
GENERAL CONTRACTOR'S MARKUPS:											
PROFIT ON SUBCONTRACT					5%						$111
DIVISION 15 - HVAC TOTAL											$2,322

B-REACTOR PHASE II FEASIBILITY STUDY	MEIER Enterprises, Inc.	Date:	6/16/00
Job No. 3036.0	Construction Cost Estimate	Prepared by:	RDR
DIVISION 15: MECHANICAL (SUBPROJECT 2)		Checked by:	

			MANHOURS				MATERIAL				
DESCRIPTION	QTY	UNIT	UNIT	TOTAL	$/HR	LABOR	UNIT	TOTAL	EQUIP.	SUBCONT	TOTAL
VENTILATION UPGRADES											
Split System Heat Pump w/ Ductwork	1	ea	143.75	144	40	5750	3740	3740			$9,490
Unit Heaters, 7.5 kW	1	ea	4.21	4	40	168	520	520			$688
Unit Heaters, 15 kW	2	ea	8.889	18	40	711	940	1880			$2,591
Exhaust Fan	1	ea	8	8	40	320	263	263			$583
Cutting and Patching	1	allow	40	40	40	1600	2000	2000			$3,600
Demolition	1	allow	8	8	40	320	250	250			$570
Controls	1	job	24	24	40	960	2000	2000			$2,960
Air Balancing	1	job	16	16	40	640	100	100			$740
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$5,518
PROFIT 10% (L,M,E,SC)											$2,122
PLUMBING SUBCONTRACTOR TOTAL				261.74		10469		10753			$28,862

GENERAL CONTRACTOR'S MARKUPS:		
PROFIT ON SUBCONTRACT	5%	$1,443
DIVISION 15 - HVAC TOTAL		$30,305

B-REACTOR PHASE II FEASIBILITY STUDY	**MEIER Enterprises, Inc.**	**Date:**	6/16/00
Job No. 3036.0	**Construction Cost Estimate**	**Prepared by:**	RDR
DIVISION 16: ELECTRICAL (SUBPROJECT 1)		**Checked by:**	

			MANHOURS				MATERIAL				
DESCRIPTION	**QTY**	**UNIT**	**UNIT**	**TOTAL**	**$/HR**	**LABOR**	**UNIT**	**TOTAL**	**EQUIP.**	**SUBCONT**	**TOTAL**
RESTROOM BUILDING											
Trenching and backfill, with chain trencher, 12" wide, 24" deep	200	FT	0.01	2	35	71					$71
100 Amp Panel Feeder Conduits - 1-1/4" PVC	200	FT	0.073	14.6	35	517	1.3	260			$777
100 Amp Panel Feeder Cables - 4-#6 copper, type THHN	8.4	CF	1.778	14.935	35	529	59.5	500			$1,029
Power Distribution											
Lighting Panels - 4 wire, 120/208 volts with main breaker, 100 amp main, 12 circuits	1	EA	17.021	17.021	35	805	650	650			$1,455
Electric Water Heater feeder, 1/2" EMT	15	FT	0.018	0.27	35	10	0.25	4			$14
Electric Water Heater feeder, 3-#10 copper, type THHN	0.6	CF	0.8	0.48	35	17	9.3	6			$23
Electric Water Heater feeder, Safety Switch	1	EA	2.5	2.5	35	89	53	53			$142
Exhaust Fan Feeder conduit - 1/2" rigid galvanized steel	20	FT	0.055	1.1	35	39	1.03	21			$60
Exhaust Fan feeder, 4-#12 copper, type THHN	1	CF	0.727	0.727	35	26	6.05	6			$32
Miscellaneous Lighting Panel branch circuit conduit 3/4" rigid galvanized steel	150	FT	0.1	15	35	531	1.55	233			$764
Miscellaneous Lighting Panel branch circuit, 4-#12 copper, type THHN	2	CF	0.727	1.454	35	52	7.1	14			$66
1500 W 6 Foot Baseboard Heater	4	EA	2	8	35	283	81	324			$607
500 W 3 Foot Baseboard Heater	2	EA	1	2	35	71	41	82			$153
Baseboard Heater Feeder Conduits - 3/4" rigid galvanized steel	100	FT	0.064	6.4	35	227	1.3	130			$357
Baseboard Heater Feeder, 3-#10 copper, type THHN	3	CF	0.8	2.4	35	85	9.3	28			$113
Lighting											
Surface Wrap Fluorescent Lighting	13	EA	1.143	14.859	35	526	44	572			$1,098
Exterior Wallpack Lighting	1	EA	2	2	35	71	170	170			$241
General Receptacles - GFI TYPE	6	EA	0.296	1.776	35	63	30.5	183			$246
General Wall Switches	2	EA	0.296	0.592	35	21	6.5	13			$34
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$1,893
PROFIT 10% (L,M,E,SC)											$728
ELECTRICAL SUBCONTRACTOR TOTAL				108.11		4033		3249			$9,904

GENERAL CONTRACTOR'S MARKUPS:

PROFIT ON SUBCONTRACT	5%	$495
DIVISION 16 - ELECTRICAL TOTAL		$10,399

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 16: ELECTRICAL (SUBPROJECT 2) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
VENTILATION UPGRADES											
Power Distribution											
Exhaust Fan Feeder conduit - 1/2" rigid galvanized steel	110	FT	0.055	6.05	35	214	1.03	113			$327
Exhaust Fan feeder, 4-#12 copper, type THHN	4.8	CF	0.727	3.4896	35	124	6.05	29			$153
15 KW heater feeder, 60 Amp Safety Switch	2	EA	3.478	6.956	35	246	169	338			$584
15 KW heater Feeder Conduits - 3/4" rigid galvanized steel	200	FT	0.064	12.8	35	453	1.3	260			$713
15 KW heater feeder, 4-#6 copper, type THHN	8.4	CF	1.231	10.34	35	366	25.5	214			$580
5 KW heater feeder, 30 Amp Safety Switch	1	EA	2.5	2.5	35	89	169	169			$258
5 KW heater Feeder Conduits - 3/4" rigid galvanized steel	200	FT	0.064	12.8	35	453	1.3	260			$713
5 KW heater feeder, 4-#12 copper, type THHN	8.4	CF	0.727	6.1068	35	216	6.05	51			$267
5 Ton Heat Pump Feeder, 60 Amp Safety Switch	1	EA	3.478	3.478	35	123	169	169			$292
5 Ton Heat Pump Feeder Conduits - 3/4" rigid galvanized steel	400	FT	0.064	25.6	35	907	1.3	520			$1,427
5 Ton Heat pump Feeder, 4-#8 copper, type THHN	16	CF	1	16	35	567	15.6	250			$817
Fractional Horsepower Starter	1	EA	2	2	35	71	123	123			$194
Fan Coil Feeder conduit - 1/2" rigid galvanized steel	400	FT	0.055	22	35	779	1.03	412			$1,191
Fan Coil Feeder, 4-#12 copper, type THHN	16	CF	0.727	11.632	35	412	6.05	97			$509
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$2,087
PROFIT 10% (L,M,E,SC)											$803
ELECTRICAL SUBCONTRACTOR TOTAL				141.75		5020		3005			$10,914

GENERAL CONTRACTOR'S MARKUPS:

PROFIT ON SUBCONTRACT	5%	$546
DIVISION 16 - ELECTRICAL TOTAL		$11,460

B-REACTOR PHASE II FEASIBILITY STUDY
Job No. 3036.0
DIVISION 16: ELECTRICAL (SUBPROJECT 3)

MEIER Enterprises, Inc.
Construction Cost Estimate

Date: 6/16/00
Prepared by: RDR
Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
EMERGENCY EXITS											
Miscellaneous Lighting Panel branch circuit conduit 3/4" rigid galvanized steel	500	FT	0.064	32	35	1133	1.3	650			$1,783
Miscellaneous Lighting Panel branch circuit, 4-#12 copper, type THHN	20	CF	0.727	14.54	35	515	6.05	121			$636
Lighting											
New Fluorescent Lighting	4	EA	1.143	4.572	35	162	44	176			$338
New Emergency Lighting	7	EA	2	14	35	496	160	1120			$1,616
New Exit Lighting	6	EA	1	6	35	213	105	630			$843
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$1,356
PROFIT 10% (L,M,E,SC)											$522
ELECTRICAL SUBCONTRACTOR TOTAL				71.112		2519		2697			$7,094

GENERAL CONTRACTOR'S MARKUPS:

PROFIT ON SUBCONTRACT	5%	$355
DIVISION 16 - ELECTRICAL TOTAL		$7,448

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00
Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR
DIVISION 16: ELECTRICAL (SUBPROJECT 4) | | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
ELECTRICAL UPGRADES											
15 KV cable, #2	3.6	CFT	4	14.4	35	510	184	662			$1,172
15 KV Fused Cutout Switches and Lightning arrestors	3	EA	2	6	35	213	7525	22575	71		$22,859
PVC underground duct bank, 2 - 4" conduits	120	FT	0.16	19.2	35	680	4	476			$1,156
Trenching and backfill, with chain trencher, 12" wide, 24" deep	120	FT	0.01	1.2	35	43			31		$74
Oil Filled Padmounted Transformer, loop feed, three phase 15 KV primary, 120/208 volt secondary, 112.5 KVA	1	EA	30.769	30.769	35	1090	5975	5975	259		$7,324
Service Entrance Conduits - 4" PVC coated rigid galvanized steel	20	FT	0.25	5	35	177	9	186			$363
Service Entrance Cables - 4-#500 MCM copper, type THHN	1	CF	5	5	35	177	420	420			$597
400 Amp 208Y/120 Volt 3-Phase 4-Wire Kilowatt-Hour Demand Meter w/ Base	1	EA	10	10	35	354	1225	1225			$1,579
Utility Vault Precast Concrete 6' x 10' x 6' High, 6" Thick	1	EA	28	28	35	992	1425	1425	280		$2,697
Power Distribution											
Lighting Panels - 4 wire, 120/208 volts with main breaker, 400 amp main, 42 circuits	1	EA	33.333	33.333	35	1181	2275	2275			$3,456
Miscellaneous Lighting Panel branch circuit conduit 3/4" rigid galvanized steel	5000	FT	0.064	320	35	11334	1.3	6500			$17,834
Miscellaneous Lighting Panel branch circuit, 4-#12 copper, type THHN	200	CF	0.727	145.4	35	5150	6.05	1210			$6,360
Lighting											
Rework Existing Hi-Bay Lighting	9	EA	3.333	29.997	35	1062	655	5895			$6,957
Rework Existing Fluorescent Lighting	60	EA	1.818	109.08	35	3864	81	4860			$8,724
General Receptacles	23	EA	0.296	6.808	35	241	9.5	219			$460
General Wall Switches	20	EA	0.296	5.92	35	210	6.5	130			$340
Wiremold Receptacles	72	LF	0.182	13.104	35	464	4.67	336			$800
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$21,515
PROFIT 10% (L,M,E,SC)											$8,275
ELECTRICAL SUBCONTRACTOR TOTAL				783.21		27742		54369	640.7		$112,542

GENERAL CONTRACTOR'S MARKUPS:

PROFIT ON SUBCONTRACT	5%	$5,627
DIVISION 16 - ELECTRICAL TOTAL		$118,169

B-REACTOR PHASE II FEASIBILITY STUDY | MEIER Enterprises, Inc. | Date: 6/16/00

Job No. 3036.0 | Construction Cost Estimate | Prepared by: RDR

DIVISION 17: CONTROLS (SUBPROJECT 3) | Checked by:

DESCRIPTION	QTY	UNIT	MANHOURS UNIT	MANHOURS TOTAL	$/HR	LABOR	MATERIAL UNIT	MATERIAL TOTAL	EQUIP.	SUBCONT	TOTAL
FIRE PROTECTION UPGRADES											
FIRE ALARM SYSTEM:	1	LOT	24	24	35.32	848	3650	3650			$4,498
PULL STATION	3	EA	1.103	3.309	35.32	117	68	204			$321
SMOKE DETECTOR	12	EA	1.333	15.996	35.32	565	150	1800			$2,365
STROBE	7	EA	1.194	8.358	35.32	295	47.5	333			$628
HORN	5	EA	1.194	5.97	35.32	211	36.5	183			$394
INSTALL RFAR BOX	1	LOT	24	24	35.32	848	100	100			$948
COMMUNICATIONS											
GP TELEPHONE	1	EA	4	4	35.32	141	256	256			$397
SUBCONTRACT MARKUP 8%											
OVERHEAD 26% (L,M,E)											$2,483
PROFIT 10% (L,M,E,SC)											$955
CONTROLS SUBCONTRACTOR TOTAL				85.633		3025		6526			12,989

GENERAL CONTRACTOR'S MARKUPS:

PROFIT ON SUBCONTRACT	5%	$649
DIVISION 17 - CONTROLS TOTAL		$13,639

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